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American and foreign railway practices

A very considerable amount of misinformation as to the relative merits of American and foreign railway practices has been spread by those who have undertaken a discussion of this question without a thorough knowledge of all the facts. Doubtless many of the readers of the *Railway Mechanical Engineer* were interested in the communication in our April issue from a railroad man in Latin-America, asking for information on the relative merits of British and American locomotives. One of the letters that we have received has come all the way from India and gives the viewpoint of a practical mechanical department officer who has had experience with American and British locomotives in both South America and India. It appears on another page of this issue and is commended to our readers because of the light that it throws on the different conditions under which locomotives are used in this country and abroad.

Not a few people who discuss the relative merits of equipment in the different countries, are inclined to compare their knowledge of conditions in one country, which may be up to date, with that of conditions in other countries with which they may have been familiar a number of years ago but which now is clearly out-of-date. We must not forget that with the increased labor and fuel costs in this country, the whole economic situation, so far as locomotive operation is concerned, has radically changed, even over the past decade. Equally as marked changes may have taken place in other countries and these must not be lost sight of in making comparisons. Our correspondent from India, Kenneth Cantlie, assistant locomotive superintendent of the Jodhpur Railway, has apparently kept reasonably up to date in his knowledge of conditions in the various countries, and presents a clear-cut and illuminating statement of the differences in conditions in the various countries under discussion.

Training of supervisors

Few developments have been more marked in recent years in the field of administration and management than that of foreman training. This latter designation, however, is a bit too narrow, for officers and supervisors generally have been deeply in need of the best thought and experience in the art of leadership. One marked evidence of the increased interest that has been taken in this subject has been the large number of articles which have appeared in the technical press, or even in popular magazines, and the great variety of books that have been published on various aspects of foreman training and industrial leadership. The Federal Board for Vocational Education was given the responsibility, under the provisions of the Smith-Hughes Act, of making studies and investigations and publishing reports designed to aid the states in the organization and operation of efficient vocational education. It has placed special emphasis on educational work for foremen and executives in industry. Frank Cushman, chief of the Trade and Industrial Education Service of this board, has given the railroads splendid co-operation in connection with the programs of supervisors' clubs and the intensive training of conference leaders for foreman training groups. He has recently compiled a bibliography on foreman training, covering books, pamphlets and magazine articles, which is intended to be of practical value to those who are conducting foremanship courses. It is designated as Bulletin 128, is issued by the Federal Board for Vocational Education at Washington, D. C., and will undoubtedly prove to be a valuable tool for those in railway service who are particularly interested in raising the standards of leadership.

New methods which save time

Two developments which seem to have been brought to a practical basis within past five years in connection with the maintenance of passenger car equipment have contributed to the possibility of reducing not only the shop time on such equipment but the cost of maintenance as well. These are the extensive use of lacquers and the application of both lacquer and enamel and varnish finishes by the use of the spraying method.

Several roads have, for some time, been applying lacquers for finishing steel passenger cars and, in addition, have used the same material for the finishing of locomotive tenders, cabs and jackets. The experience of some of these roads seems to be that, while it is yet too early to draw definite conclusions as to serviceability, there are indications that a material increase in the service life of the finish may reasonably be expected. On locomotives in particular, the lacquer finish seems to be more durable and in many cases it has been found possible to eliminate the complete refinishing of the parts mentioned at alternate general shoppings by merely renovating the surfaces and touching up spots from which the finish has been accidentally removed in service. As to the saving in shop time, this is not as noticeable in locomotive work as in passenger car work where it has been found possible to reduce the time required for painting by from two to five days.

The introduction of lacquers brought with it a familiarity with the spray-gun method of applying the finish. There are many classes of work now being finished with

the brush that may more effectively be finished with the spray but, in all fairness, it should be recognized that there are also classes of work in which the spray, in its present stage of development at least, can not take the place of the brush. The development of the spray has offered the painter a tool which, through judicious use, may contribute to an increase in productive capacity as well as make possible many pleasing results not obtainable with the brush.

The automobile industry has pioneered in the application of lacquer finishes by the spray method. That industry found that the adoption of these processes and methods made it possible to meet the demand for increased output in a given time with the additional advantage of great savings in shop floor space previously occupied as storage space while drying between coats.

It will be interesting to follow the service experience of those roads that have recognized the possibility of these new developments for the reason that they appear to be factors destined to play an important part in increasing the capacity of existing car repair facilities while at the same time effecting a reduction in maintenance costs insofar as the paint shop is concerned.

Freight car conditions

Since 1923, the year following the shopmen's strike, the railroads have been passing through an era of improving freight car conditions. This has resulted in a gradual decline in the percentage of freight cars which are unserviceable, in the number of cars receiving both heavy and light repairs, and in the hours of car-men's labor, for which the railroads have paid. There is evidence, however, that this period of improving conditions has reached an end, and, while it is yet too early to say that it will be followed by a period in which the condition of freight car equipment will decline from the high standard attained as a result of the past five years' work, such a decline is evident at the moment.

Since the beginning of 1925, each year has shown a well-defined cycle of high and low unserviceable percentages, the high percentages obtaining in the months of June to August and the low percentages in December. The high percentages were 8.7, 7.4, and 6.5, respectively, for the years 1925, 1926 and 1927, and the low percentages were, respectively 6.9, 5.7 and 5.9. Since December of last year, the percentage of freight cars unserviceable has been steadily increasing, as it has during each of the past few years, but in May of this year it had reached 6.9 per cent which is higher than the highest percentage of last year, with the prospect of still higher figures in one or more of the summer months.

Accompanying this evident, though slight, increase in bad-order cars, there has been a distinct reduction in the number of cars receiving heavy repairs since last fall and also a slight falling off in the number of cars which have received light repairs. During 1925 an average of approximately 69,700 cars monthly were turned out of the shops of the Class I railroads for heavy repairs. In 1926 this average was 67,300, while in 1927 it had dropped to 62,000. Similarly, in the case of light repairs, the monthly averages for the three years under consideration are 1,321,000, 1,312,000, and 1,240,000. There has been a similar falling off in the hours of carmen's labor paid for monthly, which, during 1925, averaged well over 24,000,000 hours and, in 1926, about a half million less. During 1927 it had dropped to an average of something under 21,000,000, with a continuance of the decline during the early months of 1928 until, in April, it was slightly below 20,000,000.

These facts, considered together, point to the beginning of a period of deferred maintenance of freight car equipment. Whether or not this ultimately leads to a serious impairment of the serviceability of the equipment which, it must be said, is probably at a higher standard of maintenance than at any previous period in the history of American railroads, the course of future development alone can determine.

Shop equipment and operating costs

The demands of modern transportation require equipment, both cars and locomotives, which can be used intensively in heavy service a large proportion of the time and which is not subject to failures likely to cause road delays. A high standard of maintenance is absolutely essential to satisfactory operation, and is best obtained, as has been demonstrated time and again, by raising the standard of shop practice and providing the kind of machinery, and shop and engine terminal equipment, necessary to meet changed, modern conditions.

After calling attention to what the Delaware, Lackawanna & Western has done in revising shop lay-outs and methods, including the more direct, orderly movement of repair parts and material through the shops, President J. M. Davis recently said, "Next, the machine shop equipment—because new machinery and tools are being constantly designed to reduce repair costs—was thoroughly gone over, not from the standpoint of the possible term of service which any particular unit might still possess—as that is not so important—but entirely from the viewpoint of its economic operation as compared with the latest, improved machine for performing the same type of work. If the old machine failed to measure up, out it went and in came the machine that had a producing power which justified its purchase. In other words, the entire reconditioning plant was furnished with the latest and most efficient type of machine equipment with the result that both repairs and repair parts are produced at the minimum of both time and cost."

In one case, an old journal-turning machine, in good working order but capable of turning only 7 pairs of driving wheels journals per eight-hour day, at a cost of $1.10 per pair, was replaced with an improved modern machine which did better work and turned 13 pairs of journals in eight hours at a cost of 65 cents per pair. Since this job was paid for on a piece-work basis, the operator increased his daily earnings and the railroad secured a greater output of journals, more accurately turned, at reduced unit cost. Mr. Davis called attention to the importance of modern electric and oxyacetylene welding equipment, which has done so much to revolutionize shop processes and promote economy. He also mentioned the increasing use of alloy steels in locomotive construction and the necessity for proper methods and equipment in heat-treating this steel for best results.

The problems of shop management are becoming increasingly difficult and involved, and their solution, in

the interests of reduced railroad operating costs, will necessitate exercise of the greatest care, effort and good judgment on the part of supervisory officers. One of the most important problems which confronts these men is selling their superiors to the idea that the right kind of modern equipment is essential in locomotive shops, car shops and engine houses, in order that the cost of maintenance work may be reduced as much as consistent with first-class workmanship, which will assure satisfactory equipment performance and a high percentage of availability.

Steam locomotive efficiency

In his articles entitled "Attempts to increase steam locomotive efficiency," the first of which appeared in the July issue and the second and concluding one of which will be found elsewhere in this issue, A. I. Lipetz has done much to clarify the thought of those who are giving serious attention to the possibilities for future improvements in locomotive fuel efficiency. He has pointed out clearly the three efficiencies which control the ultimate proportion of the heat in the fuel which can be converted into useful work at the rims of the drivers—the boiler efficiency, the engine efficiency and the machine efficiency. He makes the point that with front end temperatures approaching 600 deg. F. and the consequent stack loss of at least 12 per cent, a two per cent radiation loss, and a combustion efficiency of 95 per cent, the maximum boiler efficiency obtainable does not exceed 81.6 per cent, and calls attention to the fact that boiler efficiencies ranging from 75 to 80 per cent have already been attained. This would seem to eliminate the boiler as a fruitful field for future improvements affecting fuel economy.

In the case of engine efficiencies, he points out the relatively greater theoretical possibilities for increasing engine efficiency offered by lowering exhaust pressures than are offered by increasing admission pressures, and, in the course of his review of the various developments here and abroad in which attempts are being made to take advantage of these two possibilities, it becomes evident that there are great practical mechanical difficulties to be overcome if either of these possibilities is to be realized in extensive measure. To reduce back pressure materially, some form of condenser is required, and condenser apparatus is not only expensive to provide, but is extremely difficult to provide in sufficient capacity to transfer the amount of heat required in locomotives of the large horsepower capacity generally desired in America. To utilize the advantage of high initial pressure, he calls attention to the necessity for high expansion ratios—which soon become much higher than seem practicable in the reciprocating-engine type of locomotive. With respect to machine efficiency, he points out that this is already from 80 to 90 per cent, leaving room for but slight improvement in the future.

An interesting and highly significant fact should be observed with respect to locomotive boiler and machine efficiencies—a fact pointed out by Mr. Lipetz—and that is that the high efficiencies, which leave little room for improvement, are obtained at a low rate of working in the case of boiler efficiency, and high tractive force in the case of machine efficiency, these efficiencies dropping off to some extent with increases in the rate of firing and decreases in the tractive force, respectively.

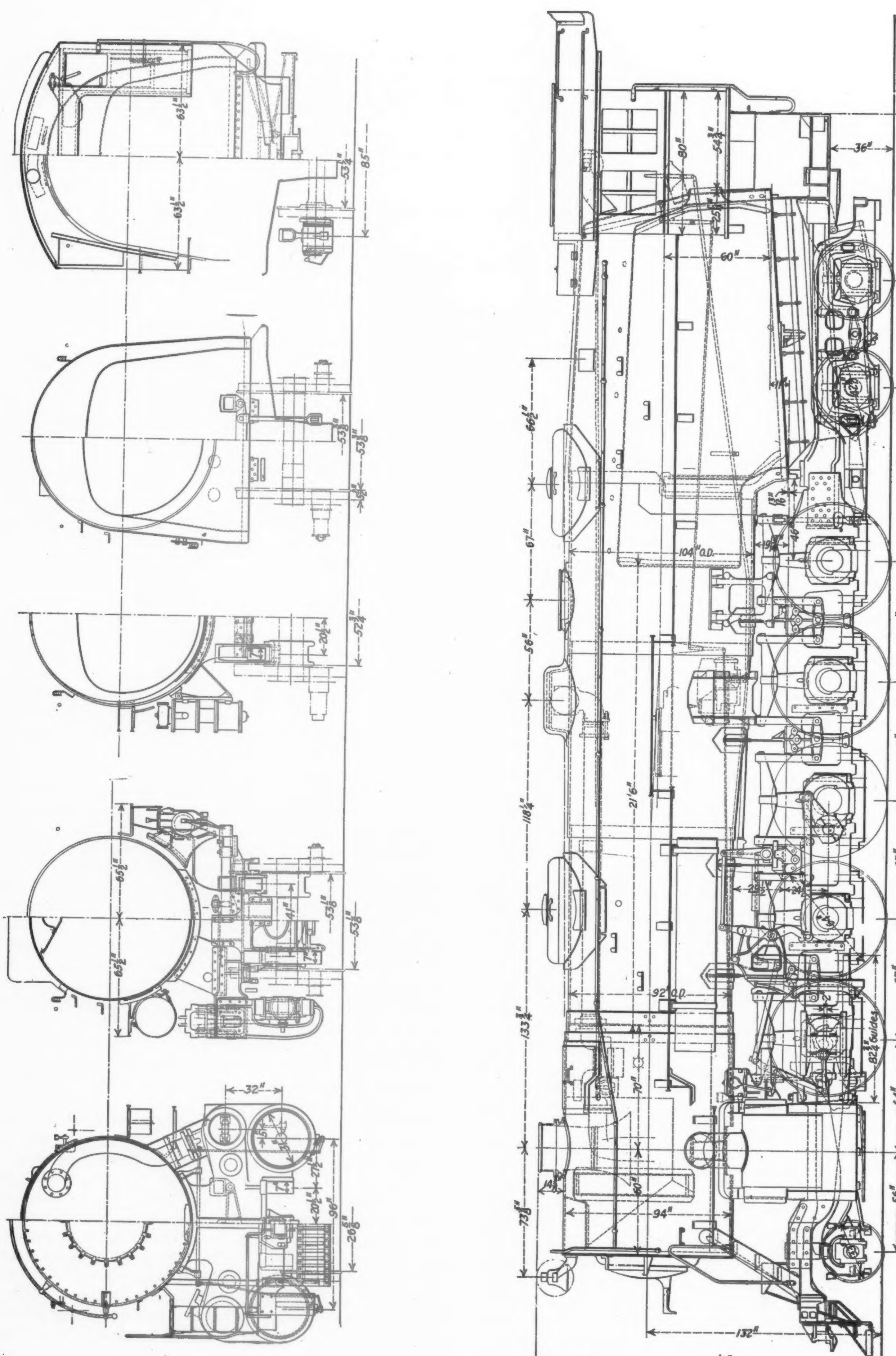
Many locomotive boilers which approach the limit of efficiency set forth by Mr. Lipetz develop a rapid and straight-line decrease in efficiency which, in some cases, drops below 50 per cent as the boiler approaches its maximum capacity. The over-the-division average in such cases is likely to be ten or more points under the maximum, representing an average requirement of at least one-eighth more fuel than is indicated by the maximum efficiency at low working rates. The significant fact with respect to this condition is that the drop in boiler efficiency is almost entirely due to a decrease in combustion efficiency, the boiler continuing to absorb a uniformly high percentage of the heat made available in the fire box, irrespective of the rate of working. Recognition of this fact has led to increasing the proportionate size of grates, and locomotives in the design of which this idea has been incorporated have given good accounts of themselves.

But there are factors affecting the efficiency of combustion other than the grate area. Considering the fact that in tests where the locomotives are carefully fired a relatively small percentage of the fuel losses from incomplete combustion are caused by carbon monoxide or unburned hydrogen, by far the greater proportion of these losses resulting from unconsumed carbon which leaves the firebox in its solid state, the grate itself would seem to offer possibilities, not only for reducing the relatively small ashpan losses, but also for effecting a distribution of air through the fuel bed in such a way as to reduce cinder losses at all combustion rates, as compared with the losses of the fuel burned on the conventional types of grates.

Another direction in which there is room for improvement in the conventional type of steam locomotive is in the drafting. Several successful attempts have been made to increase the efficiency of draft production over that generally prevailing. Such attempts, in which the necessary draft through the fire is produced with a minimum of cylinder back pressure, not only tend to increase combustion efficiency by reducing the violence of the agitation of the fuel bed, but also effect some improvement in engine efficiency by reducing cylinder back pressure. It is probable that few engineers are prepared to say today that the ultimate has yet been reached in this direction. Granting that it has, however, the field is still great for the application of these ultimate improvements, now confined to but a few roads.

The situation with respect to machine efficiency is somewhat parallel to that with respect to boiler efficiency. Many of the locomotives for which test data are available show a marked tendency for a decrease in efficiency at low draw bar pulls. The possibility for an appreciable improvement in this case is perhaps not as great as in the case of combustion efficiency. The present activity in the development of improved methods of lubrication, however, suggests the possibility of the re-introduction of oil, in the place of grease, for the lubrication of the principal machinery bearings, with at least some improvement in machine efficiency.

While none of the possibilities here set forth for improving the efficiency of the locomotive is as great as the theoretical possibilities obtainable from the use of a condenser and high boiler pressures, there is this to be said in their favor: They do not require major changes in the established form of the locomotive—changes which cannot be obtained without a material increase in the first cost and some sacrifice of reliability, for a time, at least. Improvements made in the directions indicated will entail a relatively small, if any, increase in first cost. They would, therefore, seem to offer the most immediate fruitful field for development and extension in American locomotive service.



Elevation and cross-sections of the Burlington 2-10-4 type freight locomotive

Burlington 2-10-4 freight engine

Two-cylinder, limited cut-off locomotive effects marked savings in fuel, water and road time

TWELVE 2-10-4 type locomotives, built for the Chicago, Burlington & Quincy by the Baldwin Locomotive works in the latter part of 1927, have now been in service about five months hauling 8,000-ton and heavier coal trains up the .3 per cent ruling grades on the Beardstown division of that road. From the point of view of weight, tractive force, cylinder horsepower, sustained boiler capacity and almost any other factor commonly considered in comparing steam motive-power units, these are believed to be the largest and most powerful two-cylinder locomotives ever built.

Designed to increase the tons handled per train, to effect a reduction in overtime paid for, and to obtain the greatest possible fuel economy, these locomotives replace 2-10-2 type locomotives with a tractive force of 81,600 lb., Type A superheaters and feedwater heaters and built by the Baldwin Locomotive Works in 1914 and 1915. In the design of the new 2-10-4 type locomotive, the tractive force has been increased 10 per cent, or to 90,000 lb. Owing principally to the use of high steam pressure and large boiler capacity, the available horsepower, however, has been increased 30 per cent over that of the 2-10-2 type locomotive, based on a co-efficient of mean effective pressure obtained from actual tests of limited cut-off locomotives; but according to the American Railway Association formula, the tractive effort is 93,700 lb.

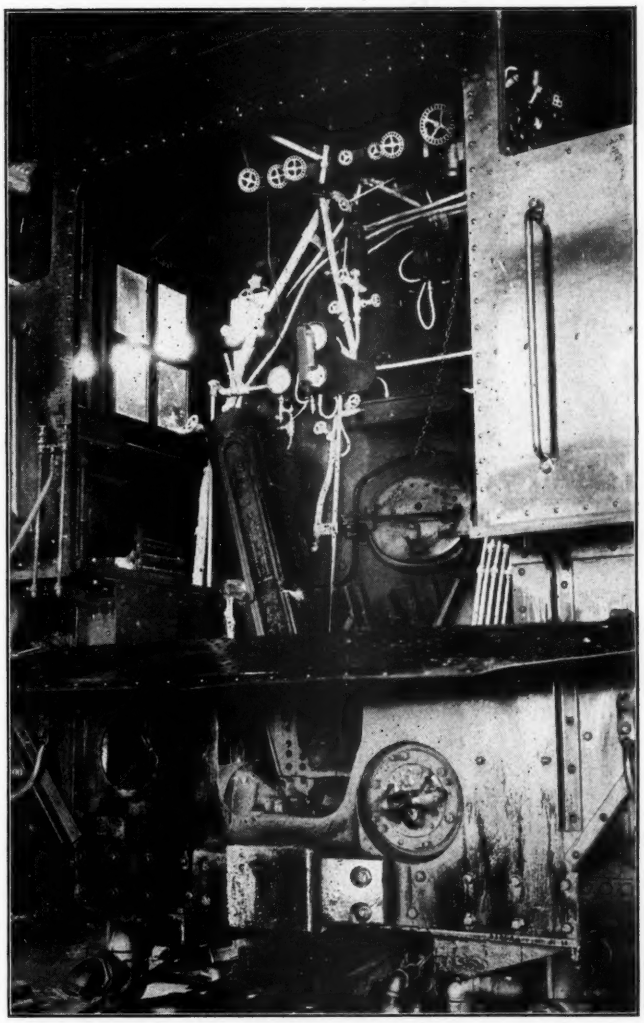
Service test results

The new locomotives have been in service about five months, and a record of their performance as compared with the performance of the 2-10-2 type locomotives, shows that the average train, northbound, has increased from 97 cars of 6,800 gross tons, to 113 cars of 8,000 gross tons, also, the overtime per round trip has been cut from 3 hours, 20 min., to one hour, 30 min., with a possibility of further reductions after the new locomotives have been in service long enough to permit lifting the speed restriction of 25 miles an hour placed on them. Since the trains hauled southbound are made up mostly of empty cars, the train load in this direction is not materially increased, but depends largely on the number of cars hauled northbound. The increase in tonnage handled by the new type locomotive, in addition to the decrease in overtime, makes a material saving in the cost of engine and train crews as well as a considerable saving in coal and water.

On a ton-mile basis, a comparison of the tonnage trains handled with the two types of locomotives indicates that the new 2-10-4 locomotive will reduce the coal consumption about 16 per cent, the water consumption 22 per cent and the time of train and engine crews 25 per cent. These savings are not alone attributable to the economy of the locomotives themselves, but partly to the reduction in the number of trains handled and to the reduction in engine-and-train-crew overtime. The reduction in overtime is made possible by the high horsepower capacity of the locomotives, maintaining speed on the grades; also because the large coal and water capacity of the tender eliminates two and sometimes three of the water stops necessary with the older power. The elimination of coal and water stops is not only reflected in the saving of time, but has a direct bearing on the saving of coal and water used on a ton-mile basis.

General features of design

The total weight of the new 2-10-4 locomotive, is 512,110 lb., of which 353,820 lb. is carried on the drivers. The driving wheels are 64 in. in diameter;



The cab interior

the cylinders are 31 in. in diameter by 32 in. stroke, and the boiler carries 250 lb. steam pressure. With the maximum tractive force of 90,000 lb. a factor of adhesion of 3.93 is obtained.

In the interest of fuel economy the locomotive has been built with 61.4 per cent limited cut-off, Type E superheater, and feedwater heater. Six locomotives are equipped with Elesco and six with Worthington heaters. Superheated steam is used for operating the

two 8½-in. cross-compound air compressors, the feed-water pump, stoker engine, headlight generator turbine, and blower.

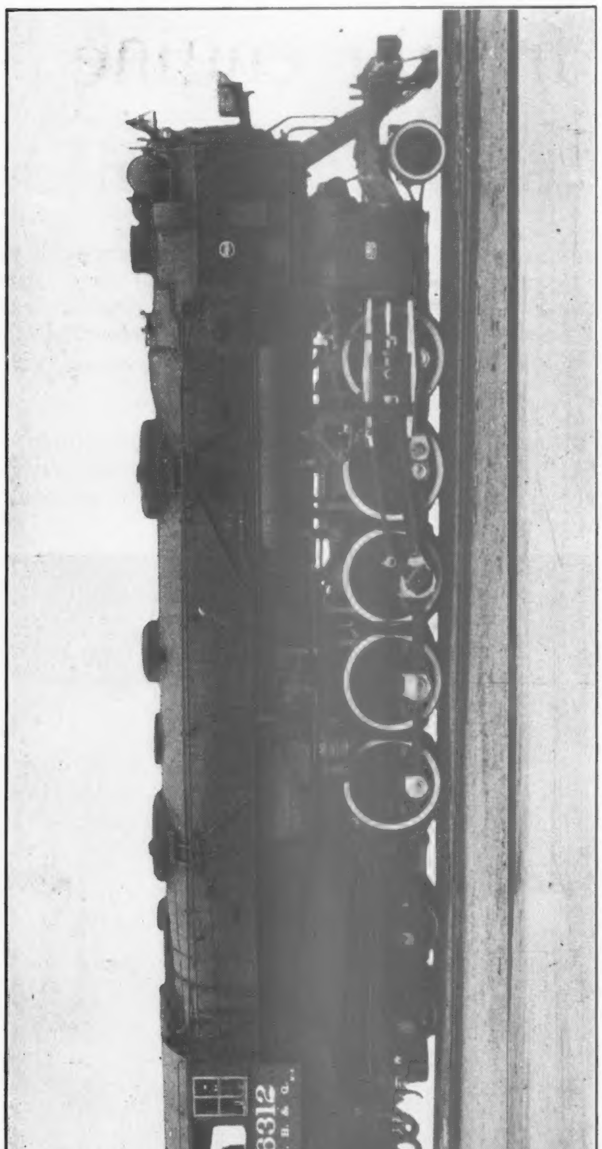
While not provided with boosters, the trailing trucks are arranged for their application later if desired. The

Performance record of tonnage trains between Beardstown, Ill., and Centralia

Type of locomotive	2–10–2	2–10–4
Northbound, Centralia to Beardstown:		
Tonnage rating	6,800	8,000
Average number of cars in train	97	113
Tons of coal used per trip	26.3	24.9
Gallons of water used per trip	39,650	33,750
Average time on road, hrs.-min.	13–29	11–37
Average time in motion, hrs.-min.	8–50	8–58
Southbound, Beardstown to Centralia:		
Tonnage rating	2,000	2,500
Average number of cars in train	100	125
Tons of coal used per trip	20.2	21.4
Gallons of water used per trip	29,100	30,200
Average time on road, hrs.-min.	10–17	8–36
Average time in motion, hrs.-min.	6–35	6–20
Per round trip:		
Hundred ton-miles	11,734	14,000
Tons of coal used	46.5	46.3
Gallons of water used	68,750	63,950
Time, hours of engine and train crews	26–20	23–32
Per cent saving on ton-mile basis:		
Saving of coal		16
Saving of water		22
Saving in time of crews		25

Baker valve gear is set to give a normal maximum cut-off of 61.4 per cent, the design permitting this to be increased to 65 per cent if desired at some future time. However, for starting and at extremely low speeds, a maximum cut-off of about 80 per cent is made available by the small auxiliary steam ports in the valve bushings.

Graduated application of power to the train is obtained by means of an American multiple throttle, and it is expected that this feature will be a substantial aid in the reduction of the break-in twos, which sometimes accompany the operation of mile-long trains. Other features in the equipment of the locomotives are Hulson grates, Barco power reverse gear, tandem main rods, Crisco main driving boxes fitted with supplemental thrust blocks and Strombos quadruplex air whistle. In fact, without either the tandem main-rod drive or the main-box thrust blocks it would be impossible to take care of the piston thrusts developed in this design. With 31-in. cylinders and 250 lb. steam pressure, maximum piston thrusts of 189,000 lb. have to be accounted for and the tandem main rod drive distributes the average load between two pairs of crank pins, driving wheels and boxes instead of concentrating it on a single pair. In spite of the great weight and piston thrusts, bearing pressures and fiber stresses have been kept within conventional limits.

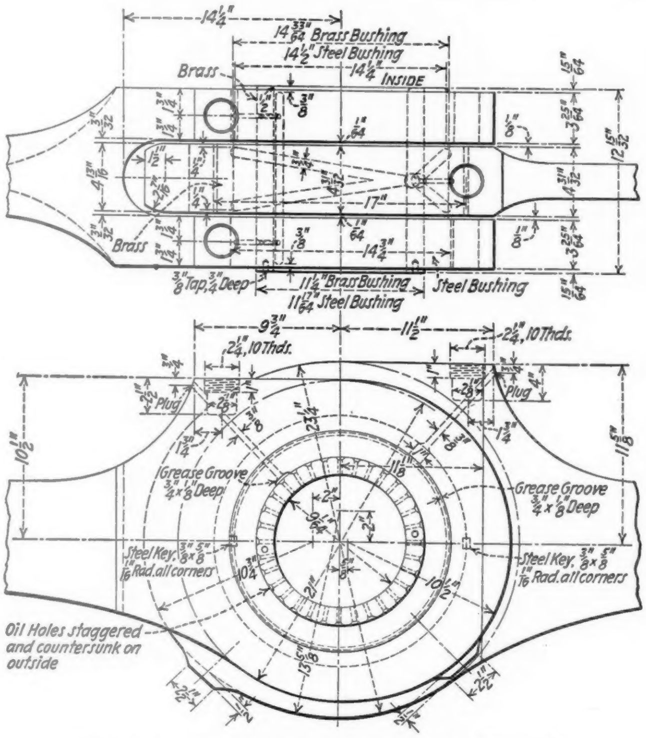


One of the twelve 2-10-4 type locomotives built for the C. B. & Q. by the Baldwin Locomotive Works

Alloy steel rods and main axles

In order to keep the weights of reciprocating and revolving parts within reasonable limits, the main rods, side rods and driving axles of the entire lot of 12 locomotives are made of quenched and tempered chrome-vanadium steel. On six of the locomotives, the piston rods, crank pins, knuckle pins and crosshead pins also are made of quenched and tempered chrome-vanadium steel. On the other six locomotives, however, these parts are made of annealed carbon steel. The use of heat-treated alloy steel in the parts mentioned permits employing fiber stresses 20 per cent in excess of those permissible with carbon steel. The main rods are of the solid back-end type with floating bushings. Side rod bushings on the No. 3, 4 and 5 crank pins also are of the floating type, principally for ease of renewal, as these rods can not readily be disconnected.

Both the engine and trailer trucks are of Commonwealth design, the latter being of the four-wheel Delta type. The engine truck is equipped with 33-in. wheels and axles having 7-in. by 14-in. journals, while the trailing trucks have 42½-in. wheels and axles with 9-in. by 14-in. journals.



Main pin connection of the tandem side rods

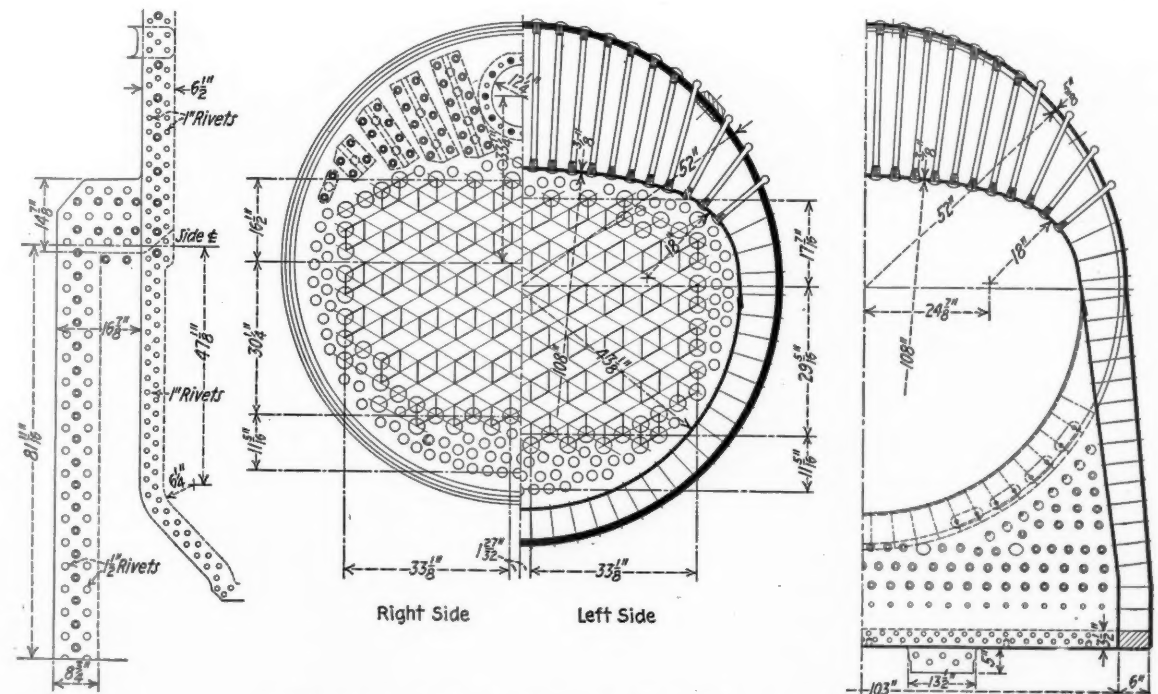
The boiler is of the radial stay, inverted wagon-top type, 92 in. in diameter. The barrel contains 87 2¼-in. fire tubes and 222 3½-in. superheater flues 21 ft. 6 in. long. The firebox is 150 in. long by 102 in. wide, inside the sheets, which gives a grate area of 106.5 sq ft. Bituminous coal is used for fuel, being supplied to the firebox by a Duplex stoker. The total evaporating surface is 5,904 sq. ft., which is made up of 5,455 sq. ft. in tubes and flues, and 449 sq. ft. in combustion chamber, firebox, and arch tubes. The total superheating surface is 2,487 sq. ft., making the combined superheating and evaporating surface 8,391 sq. ft.

The tender was designed to make two water stops on the 135-mile division, at least one and possibly both of these stops being made where coal chutes are located. The tank is of the rectangular type, carried on a Commonwealth steel underframe, and Commonwealth six-wheel trucks. The tender has a capacity to carry 24 tons of coal and 21,500 gal. of water. Wheels used under the tender are of rolled steel, 36 inches in diameter, and axles have 6½-in. by 12-in. journals.

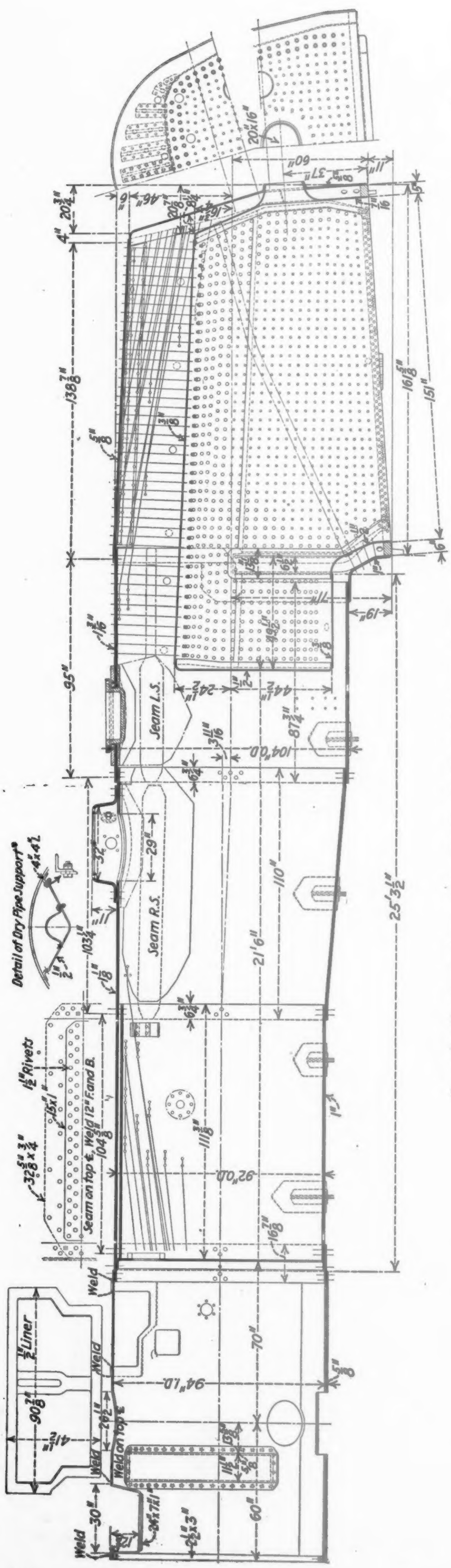
The general dimensions of the new Burlington 2-10-4 type locomotive are shown in the table.

Table of dimensions, weights, and proportions

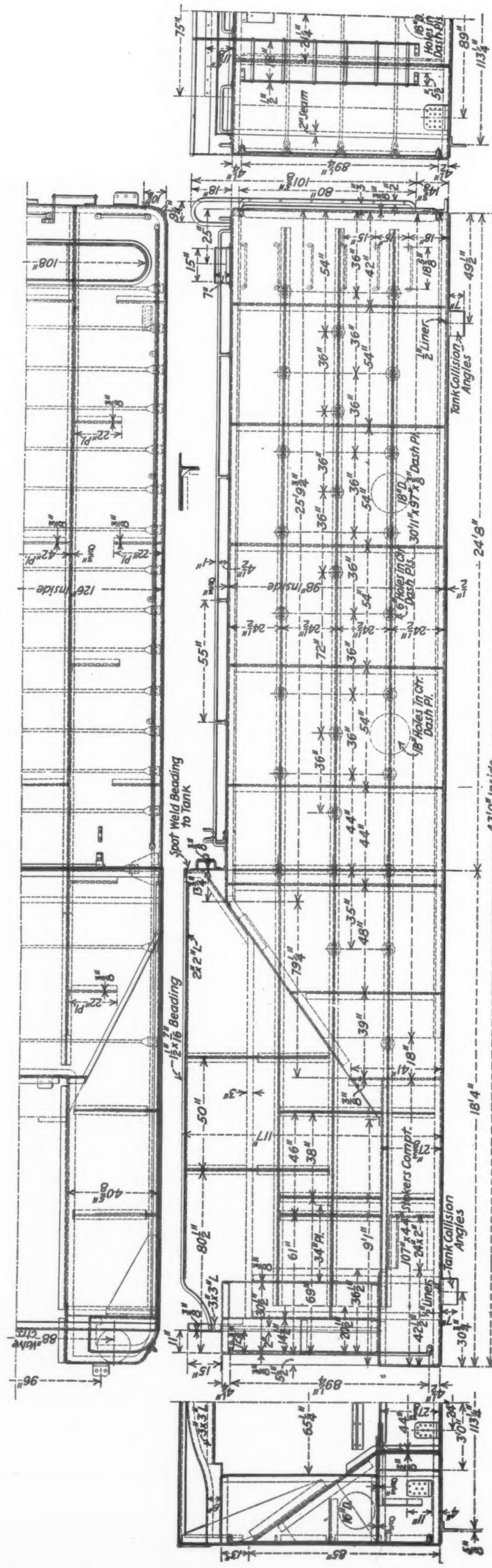
Service	Heavy freight
Cylinders, diameter and stroke	31 in. by 32 in.
Valve Gear	Baker
Valves: Piston type, diameter	15 in.
Maximum travel	8½ in.
Steam lap	2½ in.
Exhaust lap	1/16 in.
Lead	¼ in.
Maximum cut-off, main ports	61.4 per cent
Maximum cut-off, auxiliary ports	80 per cent
Weights in working order:	
On drivers	353,820 lb.
On engine truck	47,920 lb.
On trailing truck	110,370 lb.
Total engine	512,110 lb.
Tender	385,800 lb.
Total engine and tender	897,910 lb.
Wheel bases:	
Driving	22 ft. 4 in.
Total engine	45 ft. 6 in.
Total engine and tender	95 ft. 11¾ in.
Wheels, diameter outside tires:	
Driving	64 in.
Engine truck	33 in.
Trailing truck	42½ in.
Journals, diameter and length:	
Driving, main	14 in. by 14 in.
Driving, other	12 in. by 14 in.
Engine truck	7 in. by 14 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Inverted wagon top;



Cross-sections of the boiler and layout of the throat-sheet seam



Longitudinal section of the C. B. & Q. 2-10-4 type locomotive boiler



The tender, which has a capacity of 21,500 gallons of water and 24 tons of coal

Steam pressure	250 lb.
Fuel, kind	Bituminous
Diameter	92 in.
Firebox, length and width	150 1/16 in. by 102 3/4 in.
Height, mud ring to crown sheet, back	76 3/4 in.
Height, mud ring to crown sheet, front	95 1/2 in.
Arch tubes, number and diameter	4—3 1/2 in.
Tubes, number and diameter	87—2 1/4 in.
Flues, number and diameter	222—3 1/2 in.
Length over tube sheets	21 ft. 6 in.
Grate area	106.5 sq. ft.
Heating surfaces:	
Firebox	302 sq. ft.
Combustion chamber	107 sq. ft.
Arch tubes	40 sq. ft.
Tubes and flues	5,455 sq. ft.
Total evaporative surface	5,904 sq. ft.
Superheating surface	2,487 sq. ft.
Total evaporative and superheating	8,391 sq. ft.
Tender:	
Water capacity	21,500 U. S. gallons
Fuel capacity	24 tons
Wheels, diameter	36 in.
Journals, diameter and length	6 1/2 in. by 12 in.
Maximum tractive force:	
Rated	90,000 lb.
A. R. A. formula	93,700 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine	0.69
Weight on drivers ÷ tractive force	3.93
Total weight engine ÷ total heating surface	61.3
Boiler proportions:	
Tractive force ÷ combined heating surface	10.72
Tractive force × diameter drivers ÷ combined heating surface	686
Firebox heating surface ÷ grate area	4.22
Firebox heating surface in per cent of evaporative surface	7.61
Superheating surface in per cent of evaporative surface	42.1

British and American locomotives

Radical differences in conditions make accurate comparisons difficult

By Kenneth Cantlie

Assistant locomotive superintendent, Jodhpur Railway, Jodhpur, Rajputana, India.

I SHOULD like very much to make a belated comment on the points raised in the article entitled "Some Questions!" in the April *Railway Mechanical Engineer,* since I have had the opportunity, both in this country and in South America of observing American and British locomotives of equal capacity doing the same work under the same conditions.

In the first place I consider that the form in which the questions were asked was not, perhaps, very tactful, since American engineers will, of course, resent the imputation that American locomotives are in every respect inferior to British locomotives. For this reason I anticipate that the replies received by you will be more in the nature of a general decrial of British practice than of the judicious weighment and selection of the good points of each.

Conditions vary greatly

The first statement is "British locomotives are far superior to those of America." This is rather vague. Is design, operation, or both, intended? As to design, it is advisable to remember that British locomotives are designed to operate in the United Kingdom and American locomotives in the United States. In the United Kingdom conditions call for small "snappy" engines pulling light loads at high speed, burning Welsh coal, evaporating pure water and running over well laid and comparatively level tracks, while the necessary limitations in the size of the locomotives call for shed staff capable of keeping them in the very best condition. In the United States, on the other hand, the loading gage and the weight of trains allow of and necessitate a locomotive of large size with a big reserve of power when burning an inferior grade of fuel, capable of using untreated water, often contending with heavy grades and able to run over inferior roadbeds whenever required, while good roundhouse staffs are sometimes hard to procure.

This is no reflection on American railroads, for the difference in conditions prevents any fair comparison being made.

If the average roadbed is better and easier in England, the cause is merely that the short mileage allows of extra capital being expended per mile to bring down the subsequent running expenses. Also, whereas in Britain it appears cheaper to use a less quantity of high grade coal, the converse would appear the case in the States. British shed work is of high quality, not from choice, but of necessity.

That British locomotives have longer lives than have American locomotives is merely a difference in the policies of the mechanical departments.

Copper fireboxes and plate frames

The only real comparative test of American versus British locomotives is to closely observe two comparable types at work in a foreign country where both classes of engine are designed more or less for local conditions—British engines being often equalized (the majority of British railways consider equalization a luxury) and American engines having copper fireboxes, etc. As to copper fireboxes, I say that, expensive as they are, they are not only of greater thermal efficacy, but will stand up to rough treatment better than steel boxes. With reasonable care, however, steel boxes are perfectly satisfactory.

British engines with plate frames, footplates and splashers are slower in a side wind than are American engines which offer less wind resistance. This has been proved by conversion. In a derailment there is a saying that American engines break and British engines bend. This legend no doubt arose through the frame characteristics.

The workmanship of details and quality of metal used is ordinarily superior in the British product, but as the price is correspondingly higher, this is as it should be.

Taken all round, the American design of engine is more suitable to other countries than is the British, but it will be found that a good design of British engine will be neither better nor worse than a good design of American engine.

One South American railway is running American, Anglo-American, and British types of equal power on the same services. Of the three the hybrid is the most

satisfactory, combining as it does many of the good points of each.

American locomotives are almost invariably excellent steamers and usually superior to the British locomotive, due to many British manufacturers being obsessed with the idea that Welsh coal will be used.

Train speeds

As to which country runs the faster trains it is as well to remember that British trains are still timber built and the weight is cut to a minimum, an ordinary passenger car seldom weighing more than 65,000 lbs. and a sleeping car 100,000 lbs. With good tracks and light trains, one would, therefore, be surprised if the average speed of passenger trains was not higher in England. As to "crack" trains, the palm can go to any administration that considers that the advertisement of high speed justifies the extra expense and trouble of fast running. The Great Western has apparently found that it does.

There is no doubt that Britain runs the largest nonstop trains in the world. The 'Cornish Riviera Limited,' 249 miles, 'The Royal Scot,' 299 miles, and 'The Flying Scotsman,' 392 miles, being the three best examples. These are run mainly for publicity and are a result of the keen interest that the British public takes in its railways.

Sleeping cars in Britain are better than those in the United States and fares are higher. No more need be said. When the American public requires brass bedsteads and separate cubicles for each person, and is willing to pay for them, American railroads will be only too pleased to provide them.

The old hand-method of riveting boilers is, in my opinion, slightly more reliable than the air-hammer method, but both are vastly inferior to the hydraulic system.

British track was once "double-headed" and is still carried in "chairs" (not sleepers) which are carried on sleepers (ties). The double-headed system was abandoned when steel rails came in, but the capital cost of conversion to the flat-bottom rail would be enormous and unjustified. This track is on the whole satisfactory and incidently more silent and flexible than the flat-bottom type.

Explodes a fallacy

Your correspondent states that British locomotives will not run on American railroads as they are too "perfectly made," while the contrary is equally impossible as British roadbeds are too rigid. British locomotives, on the contrary, have occasionally run on American railroads, as happened when a Great Western locomotive was sent to the United States last year, and have neither derailed nor suffered damage at high speed. The loading gage is the only obstacle to locomotives from American railways running in Britain. Could they do so, they would no doubt acquit themselves with as much credit as the converse.

British locomotives have, perhaps, a higher reputation in the eyes of the world. If so, this is for one reason only: In buying a British locomotive there is reasonable assurance that it will be a good sound article with a long life and reasonable economy in operation, while an American locomotive may prove the best engine on the railway, and, on the other hand, it may not. Many people prefer not to speculate when buying expensive things like locomotives.

Both American and British designers have foibles in design and construction, and I am convinced that the best practice lies somewhere between the two types.

High pressure locomotive built in Switzerland

A BRIEF description of a new 850-lb. pressure steam locomotive which was built the latter part of 1927 by the Swiss Locomotive & Machine Works, Winterthur, Switzerland, was published in the March 9, 1928, issue of the Engineer, London, Eng., page 274. The Engineer states that this locomotive was built for experimental purposes after several years of research work, preliminary trials and satisfactory tests. The boiler of this novel locomotive works at a pressure of 850 lb. per sq. in., and a high speed three-cylinder, noncompound engine operates the drivers through a geared jack shaft. In the middle of January, 1928, comparative road tests on the sections Winterthur-Romanshorn and Winterthur-Stein-Säckingen, were made with a conventional superheated steam locomotive of 170 lb. per square inch pressure, and of equal output in order to ascertain the savings of coal and water obtainable with the high-pressure locomotive. Non-stop runs took place on consecutive days between Winterthur-Romanshorn and Winterthur-Stein-Säckingen, the composition of the train and the weather being the same for each two comparative runs. The tests were made under the control of the officers of the Swiss Federal Railways. The recorded test figures are given as follows:

Sections	Winterthur-Romanshorn and back		Winterthur-Stein-Säckingen and back	
Length in miles	70		93	
Maximum gradient, per cent	.835		1.25	
Weight of train behind drawbar, tons	242		300	
Number of axles	31		40	
	High pressure	Low pressure	High pressure	Low pressure
Average speed, m.p.h.	38.4	37.7	34.2	33.2
Coal consumption, lb.	1,710	2,600	2,230	3,200
Water consumption, gal.	1,358	2,522	1,700	3,170

It is claimed that there is a saving of coal of from 35 to 40 per cent with respect to the horsepower-hour at the drawbar and a water economy of from 47 to 55 per cent.

* * *

A study of comparisons—A 2½-ton industrial switcher suspended on a 10-ton crane beside a 2-8-4 type in the Battle Creek, Mich., shops of the Grand Trunk Western

Cows, machines and bottlenecks*

Bill Babbitt's farm policies stimulate Tom James' imagination—He finds railroad shop equipment highly specialized

THE morning that Tom James of the Commercial Engineering Company called upon Purchasing Agent Shafer of the Carbon Valley Railroad, was also the morning that Purchasing Agent Shafer received a letter from Master Mechanic Highball Scott. Highball's letter suggested that a few days fishing would be highly beneficial to the two faithful employees of the Carbon Valley Railroad. The letter was in accordance with tentative plans previously made.

Shafer remembered Tom James as a member of the party occupying the smoking compartment of a Pullman at the time the Carbon Valley "Ranger" was delayed at Briggs Crossing. The two enjoyed a hearty laugh over Highball's discourse on railroading directed towards Professor Jackson of Awanna Township High School, who had unwisely and in the presence of Highball Scott,

The purchasing agent is observed making a purchase

criticized railroad operation. It was not a difficult matter for the purchasing agent to persuade Tom James that fishing trips reflected certain direct benefits to sales and engineering men, as well as to railroad men. During the conversation the name of the former machine tool salesman, Bill Babbitt, was mentioned. As the Evergreen Nursery Farms were located in the upper reaches of Carbon Valley, there was no reason why a few hours stop could not be made at Babbitt's farm. Tom James enumerated a list of select eatables which formed the mainstay of farm dinners. Shafer modestly admitted that he himself was a bear for fried chicken, home cured ham, country sausage, and certain other light articles of diet which were admitted to be non-injurious to husky farm hands.

Tom James—Observer

After a 'phone call to Highball Scott, the trip was arranged for a week from the following Thursday.

* The third of a series of stories by a railroad man who was once a peddler.

Tom James arrived at Shafer's residence bright and early on the day appointed. It was a delightful run up to Rockside shops—one of those summer mornings, after a rainfall, when nature looks its best. A fine concrete road winding its way up through the valley, around hilly knobs well covered with forests. Birds doing their best for the entertainment of the visitors, squirrels perched on rock or stump and—wonder of wonders—back in the corner of a pasture, close to the woods and remote from the road, two deer grazing. Shafer's car fitted exactly in with the happiness of the morning; a good machine gliding smoothly up the grades and swinging the bends gracefully.

Tom James, as the observer of the party, found ample food for comment on the various scenes viewed along the route. The concrete road and the bridges over which the car progressed were carefully observed. The probable number of years before some of the second growth timber would mature was another object of interest.

In due time Highball's headquarters were reached and the three proceeded toward Evergreen Farms. During a stop at a wayside gasoline station, Tom James examined the tires of Shafer's car, and also made a mental note of the conversation between Shafer and the gas station proprietor while the gas tank was being filled and a little oil added to the crank case. Tom James observed the purchasing agent making a purchase.

Evergreen nursery farms

Bill Babbitt had mentioned that he was the owner of the Evergreen Nursery Farms, but had not mentioned that he was the owner of the best farm in the upper Carbon Valley country. In addition to the nursery business, Bill raised some good stock and also bountiful crops.

Bill made the party highly welcome and assured Highball Scott that he had given his recent request for fishing information full and due consideration, and that he was pleased to announce that arrangements had been made to enable his visitors to enjoy their outing in the fullest measure, but first, before going on to their destination, the party would be his guests at Evergreen Farms and enjoy a country dinner with him. The polite protests from the three visitors were in the tone of those who expected their refusals to be overruled. Such was the case and presently all were agreed that the next meal would be at Evergreen Farms.

Probably Tom James enjoyed the visit more than the other guests. Babbitt showed the party his residence, completely equipped with modern conveniences; a barn with running water for the stock; milking machines, and freshly whitewashed stable walls and ceilings. He pointed out his poultry houses and yards. Over in the hog lot the party inspected a family of porkers—the pride of Bill's second oldest son, who was attempting to raise a ton-litter of pigs. The tool house, however, appeared to be the center of the earth to Bill. Here all farm tools not in active use were carefully housed. Here, also, was a small gasoline engine, a lathe and a drill.

From the tool house Babbitt and his guests returned to the farm house where dinner was being prepared. After the usual cleaning up, and other preliminaries enjoyed by railroad men before a meal, Bill escorted his guests to the dining room to meet the members of his family. Mrs. Babbitt was introduced as owner of the concern. Bill, Jr. and Chuck, the young farmer with ambitions towards a ton-litter of hogs, were introduced respectively as farm engineer and vice-president in charge of hogs. The lesser members of the family were introduced in turn with Bill's concluding general introduction that "A better grade of Babbitt could not be found in the Carbon Valley". The meal was entirely up to Tom James' expectations. Highball Scott's face beamed full and red as a harvest moon as he, with the other guests, left the party and stepped into Bill's office for a smoke and chat.

"Your machine shop out in your tool house interests me," said Highball Scott. "Who is the machinist?"

"Well," replied Bill, "either of my sons is handy enough to do a little job of machine work, if necessary, and I once served an apprenticeship at the trade myself. Since installing the machine tools, I have given the boys some instructions in the use of them."

"What line of machine shop work do you handle?" asked Highball.

"Just the odd jobs that are required in the up-keep of our farm machinery and equipment" was the answer. "We occasionally do develop minor special appliances for our own convenience in connection with farm work, and we find a few tools decidedly convenient in building these appliances."

"The question in my mind", said Tom James, "is whether it pays you to have a machine shop on your farm, when the tools are used only at infrequent periods? Would it not be more profitable for you to take your work to the nearest regular machine shop?"

"That question," replied Bill, "might be answered in exactly the same manner as a similar question pertaining to tools in shops of far greater importance than my little place. The actual cost of the work turned out in my shop is probably greater than the same piece would cost if the work were hired done in some local machine shop. But there is another side to the story.

"I have, for instance, a binder, a mowing machine and a hay loader. Any one of those machines works but a few days in the entire year, nevertheless, when once the season commences for those machines to be worked, we double-crew them and work them as many hours as we have daylight. Now, you must remember that when a crop is ready to harvest, the work must be pushed at top speed until you have your crop safely put away. I could hire the use of similar machines from some of my neighbors at less cost than I could afford to own them. However, if I depended upon my neighbors for these machines, I would secure the use of them only at the time when the machines were not in use by someone else.

"In case one of these machines breaks down—which rarely occurs—we must again get it going in the least possible time. While we drive to the nearest repair shop, await our turn to get our work done, and get back to the farm, my piece of harvesting machinery has been idle. The first cost, so far as the actual piece of work is concerned, would show a loss in the operation of my machine shop. The gain in the service hours of my farm equipment by our being ready to make any minor repairs promptly, shows a handsome profit from the operation of my shop. Or, by way of comparison, let's consider it this way. One man with a scythe can mow grass. Fact is, in the days of our forefathers, all harvesting was done in that manner. The mowing machine that worked only a few days or weeks and lay idle the remainder of the year had not been invented. Today, time and man power is too valuable to spend harvesting grass with a scythe. Hence the mower.

"To get back to the use of the machines, Bill, Jr., whom I call my farm engineer, and myself, considered all the angles of cost and return before we bought the tools. We decided that we were justified in the outlay. We have since been able to demonstrate to our own satisfaction that our decision was a wise one."

Farm engineering

"That title—farm engineer—interests me," said James. "Would you mind explaining that particular branch of engineering to me?"

"Gladly," was the answer. "My son finished an agricultural course at State College. After Bill got home, he proceeded to put some of his college training to practical use. Possibly, if you had the background, the story would be more understandable. I did not buy this farm

Bill Babbitt welcomes his friends to the farm

in the same condition as you now see it. It was in a rather run-down condition when we acquired it, which was while Bill was still in school. Before buying, Bill secured the aid of the county farm agent and had the soil tested. Thus, we knew before we purchased the farm what we might expect to raise from the soil. Myself, I have always had great respect for a competent engineer. One of my bosses once said that 'an engineer is a man who could do for a dollar what any darned fool could do for five'. Young Bill tends to apply engineering principles to everything he does; his conclusions have been so decidedly gratifying that I have christened him my farm engineer.

"You saw our cows. Onr breeding stock was purchased on a basis of quality and records first; Price, a secondary consideration. We sell a considerable amount of milk. We test and weigh the milk from each cow and thus we know what each one is producing in the way of butter fat as well as in volume.

"You saw our poultry houses. My daughter, who is quite interested in poultry raising, keeps a check on that battery of egg-turning machines. As soon as a unit commences to fall below the required production, that unit, as we would say in the shop, is 'retired account of obsolescence'.

"Our farm methods, when we commenced operations, were considered somewhat in the nature of a joke by the so called practical farmers of this district. However, our stock soon commenced taking first prizes at the county fairs, and we occasionally sell a calf for more money than some of our so called practical neighbors are able to secure for a full grown scrub animal.

"We are raising very good crops of the ordinary farm products. We have applied scientific farming methods to our fruit raising and find, there again, that a wise expenditure of capital in the beginning, followed by intelligent management and an accurate performance knowledge, is the surest road to success in this line of work.

Tom James compares farming with manufacturing

"Do you know, Bill," said Tom James, "that you run your farm almost exactly in the same manner as the large manufacturers manage their shops. I have had a fair amount of engineering experience in the industrial field and if you would substitute the words 'foundry', 'forge shop', or 'finishing department', for the words 'cows', 'chickens', and 'pigs', one would almost imagine you were describing the operation of a well managed manufacturing concern.

"I remember, Bill, the time we sat in the smoker together, that you told us we need not expect to come to your farm and find a fifteen-year old cow or a ten-year old hen on the place. You also said that a contract shop that kept a flock of pickpockets in the shape of machines from twenty to fifty years old was due for a new boss with the title 'County Sheriff.'

"You were certainly right in the second part of your statement—that a contract shop depending on worn-out equipment is due for a fall. It's a fact. I have seen it happen. I remember, at the same time that we talked, that Highball mentioned having a drill press in his shop which was harvested about the year 1890. I notice that the machine tools out in the tool house are practically up-to-date machines, and that, even for use in a farmer's tinker shop.

"Do you know, Highball, I believe you would find it highly interesting, as well as profitable, to select some bright young fellow around your plant and work him for a spell in the same capacity as Bill, junior has on the farm. Never mind about the title. Let's just select some imaginative youngster, with an inquiring turn of mind, who is not handicapped by an excess of tradition. What I mean is, that this youngster does not know enough to know what you or myself, acustomed to seeing years of routine, would consider right or wrong.

"Suppose, in place of Bill's boy's agricultural course, this youngster, even though he may be a college-trained man, visits a few good live contract shops or manufacturing plants. Go around with him yourself, and observe some of their methods, as well as the equipment used. Train the boy to acquire an insight into production from a given type machine. Also, he should get some ideas of maintenance costs. It would likewise be well for him to observe the sequence of operations in a manufacturing plant.

"Now mind," Tom continued, "I am not hinting that your shop or your methods are out of date. On the other hand, as we know that perfection is rare in this life, we may assume that your shop might show noticeable improvement over your neighbor's railroad shop just as Bill Babbitt's farm, engineered by an amateur but supervised by a hardened business man, has shown decidedly gratifying results when compared with the farms around him which are managed by what we might call practical farmers, not theorists.

"You know, Highball, it is really possible for a man to be too practical. It is possible for a man, who today is managing his business in the most up-to-date manner, to overlook the changes that are taking place as the procession moves along. What is practical and correct at the present time will, in many cases, be mighty inefficient a quarter of a century hence. While I have never been a railroader, I have learned a few things about railroad shops which I believe places them in their equipment requirements in a class by themselves. A railroad shop could not operate equipped only with highly specialized machines, as is the case in the automobile manufacturing plant. On the other hand the best contract shop on the map would fall short in comparison with a railroad shop in certain lines of production unless equipped with some tools developed especially for railroad shop work.

"You railroad shop men seem to think that your work is all of a general line of repair work. Even from what little I have seen, I know that this is a false impression. Your shops all have a few highly specialized tools which turn out wonderful performance records. You are so close to them that you do not realize what you are doing.

"Take, for example, your double-end axle lathe; your car-wheel borers, your mounting and de-mounting wheel presses; your driving-wheel lathe in your machine shop; your quartering machines; your drop tables in your roundhouse, and many other special appliances which you have; all of these machines turn out work when properly installed and efficiently handled at a rate that is surprising when contrasted with the performance of some machines alongside of them. What is your opinion, Friend Babbitt?"

"Nothing else but right," answered Bill, "but there is a reason."

The bottle neck of the shop

"Once upon a time, back in the days of wooden cars, it probably was found that car construction or repair would always be ahead of truck building or repair. That was due to the delay in securing mounted car wheels. We note, similar to Highball's five drill presses, that the machines for boring car wheels could not keep up to the demand. Consequently, some fellow investigated the condition and found that the demand was mighty pressing. When that fellow developed a machine that would bore as many car wheels in a day as two or three of the old machines would turn out, and was able to prove his talk to the satisfaction of a worried mechanical officer, he had sold a machine. More than that—he had developed a market for car-wheel borers.

"The wheel press, a single-end, 150-ton machine, was a mighty important piece of equipment when I worked around railroad shops. Before I left the machine tool business, however, the big shops were equipped with double-end wheel presses which would knock off wheels almost as fast as a school boy would club chestnuts.

"The driving wheel lathe developed a good deal on the same order. Why, men," said Bill, "I know where a driving wheel lathe was in use, although it was for turning an occasional cut journal, only a few years ago that was really an interesting object lesson. This machine apparently marked the first step of the transition of the old light-frame engine lathe into the present high-power driving-wheel lathe with a capacity of a pair of wheels

from floor to floor in thirty minutes. This old veteran was simply a large engine lathe with the cross slide so arranged as to permit the driving wheel to swing directly in front of the tool post on anything up to the full swing of the lathe. On the rear of the tail stock was mounted a bracket to carry a quartering bar.

"In the days when a railroad had only a few locomotives, these few locomotives had never more than three, and more frequently two pairs of driving wheels. When renewals of driving axles and wheel centers were infrequent, the combination single-end tire-turning and quartering machine was, doubtless, entirely satisfactory. As time passed on, and particularly after the advent of high-speed steel, the old-fashioned light driving-wheel lathes, although they were a vast improvement over the one which I have just described, in many cases constituted the bottle neck of the locomotive shop.

"What was the result? The modern wheel lathe, of course. Now it is not uncommon to see a wheel lathe standing idle 50 per cent of its time, in a shop where a few years back two wheel lathes, working overtime, gave a machine shop foreman nervous prostration.

"Now," continued Babbitt, "that brings me to something else. It is possible that machine-tool salesmen have tried to interest a prospect in a machine tool, but were unable to do so for the apparently good reason that there would not be sufficient work to keep the machine in operation half of the time. In the case of the wheel lathe which stands idle half of the time, the only expression evident concerning this apparently highly uneconomical condition is one of relief and the comforting assurance that when a congestion of driving-wheel work does occur it will be cleared away in a mighty short order. Your wheel-turning capacity may exceed its current demands by a hundred per cent without causing any noticeable inconvenience. Just as surely as the car wheel borer; the car wheel press; or the old weak-backed tire lathe once choked the flow of work in their respective departments, some other equipment some place in every shop tends to slow up output. Really, it does look inconsistent to see two 60-in. driving wheel tires turned from floor to floor in about thirty minutes or, roughly, at the rate of fifteen minutes each, while at the same time a lathe-hand nearby may spend half an hour or more making some small piece, in an engine lathe, which could be knocked out in one-tenth of the time with a special machine.

"This brings us back, of course, to the argument that because of the small quantity required, the high first cost of the machine, that the special machine would not, in the long run, be profitable. There is no question. That is absolutely right, but are your machines, Highball, equipped, for example with special appliances that will serve to bridge the gap between the standard machine and the automatic?

"I might put that in another way. If you were going to buy a machine, let's say to turn rod bushings, I don't doubt but what you would desert your old friend, the 30-in. engine lathe with a bed long enough to take six feet between centers, and cast about for some specialized chucking machine. You would finally light upon a small upright boring machine. Probably something of the side-head type with a turret tool post on the side head and another turret on the vertical slide. This could be equipped, with provision to mount eight or ten tools. It is entirely possible that, if at the same time you were buying a new engine lathe, you would buy the same old standard machine without a special attachment of any kind.

"Another thing. It is not at all uncommon to see a good machine harnessed to its load by means of totally inadequate fastenings. It is somewhat like seeing a good wagon with a well-kept team of horses attached with a worn-out or make shift harness. The inadequate harness would be the bottle neck in the hauling capacity of the farmer's transportation machine. I believe Tom James' idea is a good one in almost any shop.

"It is always easy to overlook the bottle neck if it is composed of several units instead of being composed of a single piece. I know it sounds like rank treason to a shop man to urge him to discard a machine that has been in service comparatively few years and which still may be producing as much as it ever did. However, your managements have probably often scrapped locomotives that would handle as many cars as the day they were purchased, nevertheless the locomotive became the bottle neck in caring for the increased traffic demands.

"Some of my neighbors have scrub cows. You could purchase two or three of these scrubs for the same price that one of mine may be purchased for. The scrub takes up as much space as my cow. The scrub cow eats as much. All in all, each one is just a cow; four legs, one at each corner, but one is a high-grade milk producing machine, the other is the bottle neck of the dairy business.

"Your remarks, Friend Babbitt, are highly interesting," said James, "and apparently a contracting company, a farm, or a railroad shop must be conducted on the same basic principles. Your machine shop seems to occupy the same station on your farm as is held by the specialized equipment of the railroad shop. You could have, as many farmers do, a few wrenches of various types, a rusty hatchet, possibly a worn-out file or two, and be equipped to remove parts of a machine. You could then sacrifice the time when your machine should be employed while you wait at the local repair shop.

"You could, on the other hand, load your place with gadgets for which you would have no earthly use. You have done neither one. You have taken the natural course and provided simply enough to care for your possible peak load, which in your case means a broken down machine at a busy time.—I believe that a survey of Highball's shop would interest him immeasurably.

"Mr. Shafer, you have been rather non-committal throughout the discussion. How do you like Bill's principles of farm engineering?"

"I think they are right," was the answer, "but comparing Babbitt with his neighbors, he has made a rather extensive outlay. At the same time he is justified, as the results will pay for his investment. Of course, my position is somewhat different. I could not consistently recommend spending my company's money with a lavish hand.

"Quite so, quite so, Mr. Shafer," replied James. "But when we stopped at that filling station, I noticed the tires on your car. You are equipped with first-class tires produced by a reputable maker, and when you bought oil for your motor, you did not inquire for the cheap oil. You bought the best he had."

"Certainly I did," answered Shafer. "I bought oil that I know to be good. I have used it for a long time."

"So have I," answered James. "I, too, know it to be good. Possibly our opinions in regard to the purchase of oil may throw some light on Highball's peculiarities in sometimes ordering materials which at first glance may seem rather high priced."

"Well, price is not the whole thing. In purchasing automobile oil," explained Shafer, "two oils may look alike but in worth they would be widely different."

"Right," said James. "First cost does not always tell the story in a lot of things. Come on, fellows, let's get in some fishing."

Attempts to increase steam locomotive efficiency

Efforts of American builders have been directed toward raising the admission pressure

By A. I. Lipetz

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Part II

NO attempts have been made in this country to lower the exhaust line of the locomotive steam cycle; the efforts of the locomotive builders and railroads have been directed towards raising the admission pressure.

When at the beginning of this century pressures of 225 lb. per sq. in. were applied, mostly in compound engines, it was thought that this pressure was the limit for a radial-stay firebox. Nevertheless, about 10 or 15 years later the Pennsylvania built a 2-10-0 locomotive with 250 lb. pressure, known as the I1S Class, of which hundreds have been constructed since. Now it is maintained that this is the limit for radial-stay fireboxes, although several instances are known where higher pressures were applied; these are the European turbo-locomotives referred to in Part I; namely, the first Ljungstrom locomotive with 285 lb., the second Ljungstrom locomotive for the Swedish State Railways with 300 lb. pressure, the Ljungstrom narrow-gage locomotive for Argentine and the Beyer-Peacock locomotive, both with 300 lb. pressure, and the Maffei-Zoelly locomotive with a boiler which carries a pressure of 313 lb. per sq. in.—all of which have radial-stay fireboxes. With proper staying, still higher pressures are possible, although it would be rather difficult to use very high pressure with the American type of firebox, as the flexible staybolts require large openings in the wrapper sheet and would not permit a very close spacing. The fireboxes in the European locomotives are made of copper, and are of dimensions that do not require flexible staybolts, whereas in large American fireboxes flexible staybolts are indispensable and probably would be necessary, even if the fireboxes were made of copper. Quite recently two boilers with radial-stay fireboxes, one for 275 lb. and another for 300 lb. per sq. in., have been built for the Delaware & Hudson and have now been in service for about a year. The outside roof sheet of the second boiler has been made of mild nickel steel; all other sheets in the firebox and stays are of ordinary material. It would, therefore, seem that, with the present material for fireboxes and stays, 275 to 300 lb. per sq. in. is the limit for a radial-stay firebox in this country.

Development of the Brotan firebox

When, several years ago, demands for higher pressures became very persistent and when 250 lb. pressure was considered the limit for a radial-stay firebox, it was thought necessary to replace the conventional firebox with its flat surfaces and multitude of stays, by a structure consisting of water tubes which can stand high inside pressures much better than flat surfaces. The Brotan firebox, introduced in Austria, Hungary and Russia some 20 to 25 years ago, has been taken as an example and several modifications have been tried in this country within the last several years.

The original Brotan boiler, as used in Central Europe[1], consists of a watertube firebox connected with a fire-tube boiler of the ordinary type. The firebox itself is built of a series of tubes which connect a hollow cast steel frame at the bottom of the firebox with two drums (in some designs with only one drum) placed at the top. The top drums are connected with the upper part of the barrel of the fire-tube boiler, whereas the bottom frame is connected with the bottom part of the tubular barrel by means of two return pipes. Thus it was supposed to establish very effective circulation and insure efficient evaporation.

The first locomotives with Brotan boilers were built in Austria and carried a boiler pressure of about 165 lb. per sq. in. The reason for building at that time a water tube firebox was not the use of high pressures, but the desire to reduce the maintenance cost of the fireboxes which became alarmingly high in view of bad water and high sulphur coal, at that time in use on Austrian roads.[2]

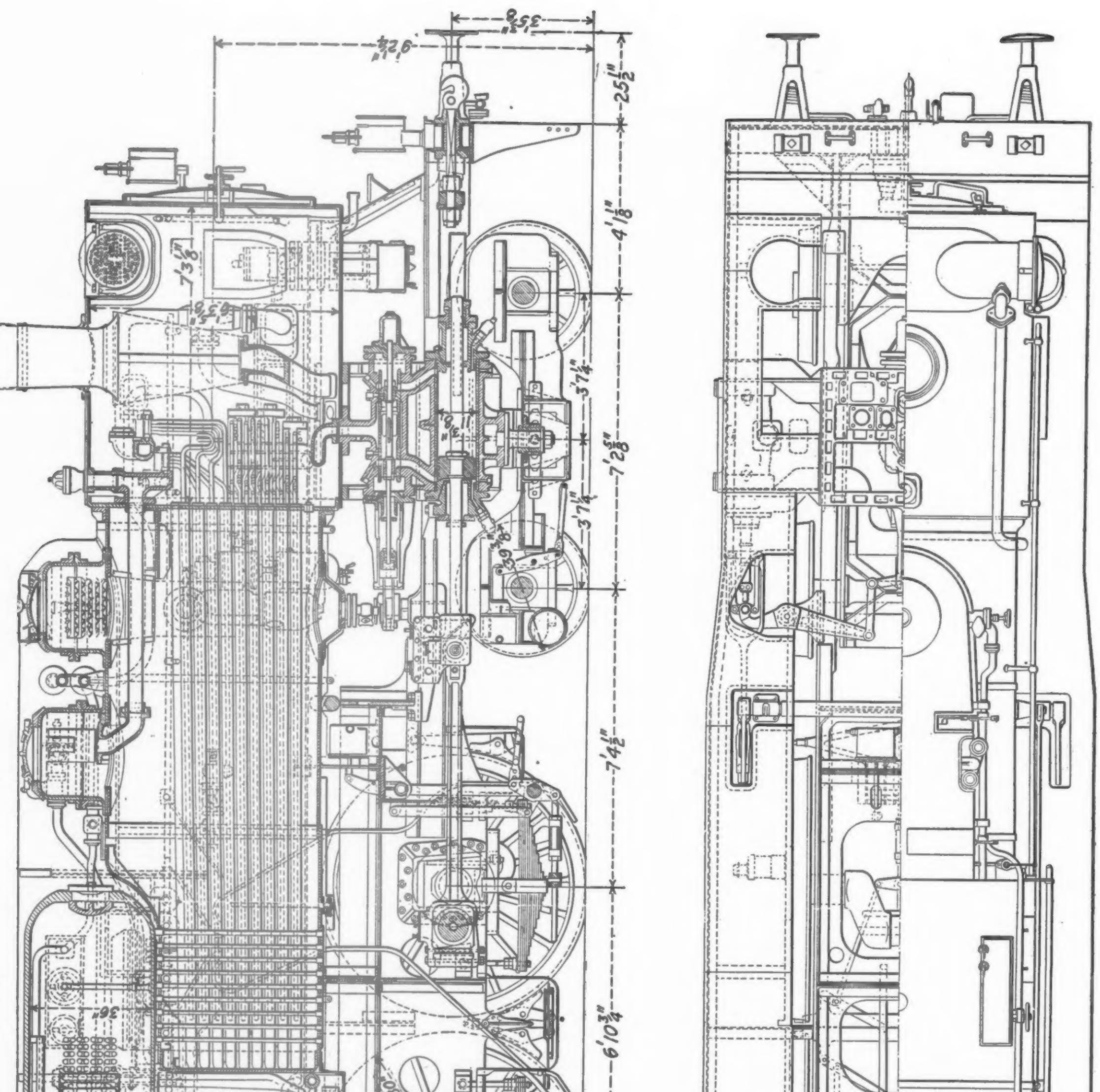
Certain difficulties were met with in the operation of these locomotives, and while these boilers were also tried in other countries (Russia, Germany and Algeria), they did not become very popular, at least outside of Hungary. In recent years this design was further developed in several scores of locomotives built for Hungary for pressures from 156 to 231 lb. per sq. in.[3]

In 1916 two locomotives were built by the American Locomotive Company for the New York, New Haven & Hartford with McClellon fireboxes which were similar to the Brotan, but differed in many details. They were built for 200 lb. pressure. Certain defects developed in these experimental boilers; they were corrected in 1920, and the service of modified boilers turned out to be so satisfactory that in 1924 a Mountain type locomotive was built with a McClellon boiler for a pressure of 250 lb. per sq. in., and since then 20 locomotives for a pressure of 265 lb. per sq. in. have been built, all by the American Locomotive Company for the New York, New Haven & Hartford.

The McClellon firebox

The McClellon firebox[4] of the later design differs from the Brotan firebox in that it has three top drums riveted together and connected with the tube sheet of the fire-tube boiler. It further has a combustion

[1] The Railway Age, May 4, 1906, pp. 758-762; also The Railroad Gazette, February 14, 1908, pp. 211-214.
[2] The use of high steam pressure in locomotives, by Professors E. C. Schmidt and J. M. Snodgrass, Mechanical Engineering, 1926, p. 1197.
[3] Railway Gazette, March 30, 1923, pp. 524-526, January 11 and 25, February 15, 1924, pp. 49-52, 104-105 & 205.
[4] *Railway Mechanical Engineer*, March, 1926, pp. 143-150.



Elevation and plan sections of the two-pressure Henschel locomotive

chamber formed by the lower surfaces of the three drums and a series of tubes which merge into the extended rear course of the barrel, near the bottom. In order to connect these tubes with the mud ring and with the tubular part of the boiler, a trough is provided which extends underneath the shell of the boiler. The firebox is braced in such a way as to form a rigid girder-box enclosing the drums and mud ring, and thus relieve the tubes of stresses from unbalanced inside pressures.

One of the 4-8-2 type N. Y., N. H. & H. locomotives, road No. 3500, equipped with a McClellon boiler was tested in comparison with a similar 4-8-2 locomotive with an ordinary boiler. The principal dimensions were alike, the cylinders were 27 in. by 30 in., the pressure in the McClellon boiler was 250 lb. per sq. in. and in the ordinary boiler, 200 lb. per sq. in. The difference in pressures was made up by the difference in maximum cutoffs, the latter being 70 per cent in engine No. 3500 with the McClellon boiler, and 85 per cent in the ordinary engine. Tests were made with a dynamometer car over the same division from New Haven, Conn., to Providence, R. I., a distance of 113 miles. The test results showed a saving of 5 per cent in water, and of 18 per cent in coal per drawbar horsepower in favor of engine No. 3500.[5] The saving in steam is the result of the higher pressure which also permitted the use of shorter cutoffs for the same load. This, in turn, should have caused a 5 per cent saving in fuel increased by the effect of better boiler efficiency due to a smaller evaporation rate, which can be estimated to be about 4 per cent, totaling 9 per cent. The rest, namely, 18—9=9 per cent, is probably due to the larger direct heating surface which also contributed to the increase in boiler efficiency. The total overall efficiency of locomotive No. 3500 was 7.47 per cent, as compared with 6.46 per cent of the ordinary locomotive.

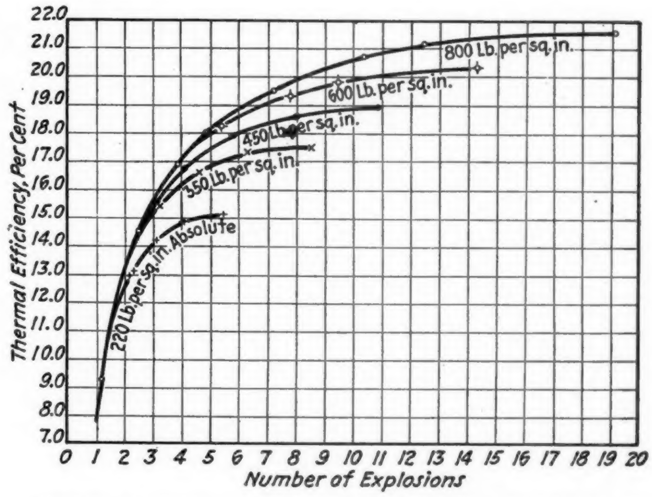
The Baldwin No. 60,000

About two years ago an experimental 4-10-2 three-cylinder compound locomotive was built by the Baldwin Locomotive Works, known as locomotive No. 60,000, with a modified Brotan boiler carrying a pressure of 350 lb. per sq. in.[6] The firebox consists of a hollow cast-steel mud ring, two drums and 4-in. tubes forming two side walls and connecting the mud ring with the drums. There are no tubes in the back head. The combustion chamber is not built into the fire-tube boiler, but is a part of the firebox, separated from the firebox proper by a brick arch. This is supported by five arch tubes which are led from the upper drums to a transverse member of the mud ring. The two drums are directly attached to the back tube sheet of the fire-tube boiler.

The locomotive has three equal cylinders 27 in. by 30 in. of which the middle is the high-pressure cylinder, and the two outside are low-pressure cylinders. The ratio of volumes is 1:2. Each cylinder has its own independent valve motion.

The rated tractive force is 82,500 lb. The weight of the locomotive is 457,500 lb. and the weight on the drivers is 338,400 lb. The factor of adhesion is thus 4.1.

The locomotive underwent very exhaustive tests on the Altoona, Pa., testing plant.[7] The consumption of steam per indicated horsepower showed a remarkable steadiness. It varied from 14.2 to 16.6 lb. per hour, which corresponds to an engine thermal efficiency of from 11.5 to 13.5 per cent. This is undoubtedly the result of combining high pressure with compounding and high superheat. The boiler efficiency varied from 71 per cent at a rate of firing of 47.6 lb. per sq. ft. of grate area per hour to 51 per cent at a rate of 143 lb. per sq. ft. The effect of the feed water heater is not included in the above figures of boiler efficiency. The mechanical efficiency of the locomotive varied from 65.9 to 89.9 per cent, and the total overall efficiency of the locomotive from coal to drawbar pull on the test plant, feed water heater included, fluctuated between 5.6 to 7.8 per cent.



Relation between cylinder efficiency and expansion for various steam pressures

During the tests a maximum tractive force of 74,764 lb. was obtained at a speed of 15.2 m.p.h. with a 90 per cent cutoff in the high-pressure cylinder. The actual factor of adhesion was thus 4.5. This tractive force, if referred to the two low-pressure cylinders only, corresponds to a mean indicated pressure of 58 per cent of the boiler pressure.

The maximum power of 4,515 i.hp. was developed at a speed of 37.6 m.p.h. with an 80 per cent cutoff in the high-pressure cylinder and 50 per cent in each of the two low-pressure cylinders. As the weight of the locomotive is 457,500 lb., the weight per horsepower (actual) is 101.5 lb.

The D. & H. high pressure locomotives

The Delaware & Hudson placed in service two high-pressure locomotives built by the American Locomotive Company; viz., in 1924 the Horatio Allen with 350 lb. pressure, and in 1927 the John B. Jervis with a pressure of 400 lb. per sq. in. These two locomotives are of the 2-8-0 type.[8] They were designed by J. E. Muhlfeld, consulting engineer for the Delaware & Hudson, and in all essentials the two locomotives are alike, differing slightly in the size of the firebox, in the pressure and in such dimensions as were caused by these changes.

The Muhlfeld boiler consists of two headers, each composed of two parallel flanged sheets riveted together. The headers are connected by four drums which project through the headers and are riveted to their flanges. The two upper drums have forward extensions riveted to a stayed saddle secured to the tubular boiler shell;

[5] Idem, p. 150
[6] Baldwin Locomotives, April, 1927, pp. 42-50, also *Railway Mechanical Engineer*, January, 1927, pp. 8-11.
[7] Locomotive No. 60,000, The Baldwin Locomotive Works, Philadelphia, 1926.

[8] *Railway Mechanical Engineer*, February, 1925, pp. 78-86, and April, 1927, pp. 207-211.

the latter is riveted to the front flange of the first header. In order to provide for communication between the four drums and the headers, and between the top drums and the saddle, each drum has circumferential ports between the two sheets of the header or saddle. The side walls are composed of 2-in. and 2½-in. tubes (in the John B. Jervis of only 2-½-in. tubes) placed between the drums in several rows similar to a marine type construction; in the Horatio Allen in six staggered rows, and five in the John B. Jervis. The two engines are of the two-cylinder cross-compound type. Their cylinders are: in the Horatio Allen 23-½ in. and 41 in. by 30 in. stroke; and in the John B. Jervis 24-¼ in. and 38 in. by 30 in. This variation is due to the difference in pressures. The rated tractive force, in both cases is a little over 70,000 lb. for compound work. At starting, when the engine can work simple, the tractive force is 85,000 lb. in addition to 18,000 lb. developed by the auxiliary locomotive on the tender. In actual service the Horatio Allen developed a tractive force of 75,000 lb., in compound, at five miles an hour, which corresponds to a combined mean indicated pressure referred to the low pressure cylinder of 48.5 per cent of boiler pressure. The actual factor of adhesion is 3.93; the estimated is 4.18, the weight on drivers being 295,000 lb.

Special tests made with the Horatio Allen on the Delaware & Hudson showed that the locomotive is very economical. An average of five runs made with a dynamometer car between Oneonta, N. Y., and Dante, over a distance of 28.76 miles with predominating grades of .5 per cent. resulted in figures [9] shown in the table.

Results of dynamometer car tests of the "Horatio Allen"

Gross tons	3125
Average speed, m.p.h.	16.5
Rate of firing, lb. per sq. ft. per hr.	57.4
Equivalent evaporation	10.7
Boiler efficiency, per cent	75.8
Average cutoff (high pressure), per cent	63.6
Average i.hp.	1814
Dry coal per i.hp.-hour, lb. (auxiliaries included)	2.197
Same per drawbar hp.-hr.	2.312
Overall thermal efficiency of locomotive, per cent	8.02

Note—The locomotive has no feedwater heater.

No figures on the John B. Jervis have been communicated so far, but the indications are that this locomotive is even more economical than the Horatio Allen.

High pressure developments in foreign countries

While in this country railroads and locomotive builders have been experimenting with pressures from 250 to 400 lb. per sq. in., raising the pressure by 100 lb. and 50 lb. at a time, the German Schmidt Superheater Company, which is well known in connection with the development of superheaters on locomotives and in stationary plants, has been conducting tests with pressures of 853 lb. per sq. in. in application to multicylinder compound reciprocating engines with different combinations of interstage heating. [10] The results of their tests could not be directly applied to locomotives in view of the complications involved, but out of the experiments a new type of a high-pressure boiler for locomotives has been developed. [11] There are two fundamental principles embodied in the boiler; first, the principle of two working pressures, a high and a moderate pressure, and, second, the principle of indirect evaporation. The boiler consists of two separate units, a high-pressure water-tube firebox with a superheater, where steam of 853 lb. pressure is generated and superheated to 750 deg. F., and a moderate-pressure fire-tube boiler where water is evaporated into steam of 199 lb. pressure and superheated in a separate superheater. This boiler works in conjunction with a three-cylinder compound engine; steam of 853 lb. pressure and 750 deg. F. temperature is admitted to the middle cylinder and after expansion and corresponding cooling is exhausted into a pipe, where it mixes with highly superheated live steam of 199 lb. pressure from the fire-tube boiler and the second superheater, and enters the two low-pressure cylinders. A temperature of 570 deg. F. is obtained. After having performed the work it is exhausted into atmosphere in the ordinary way.

The other principle—of indirect evaporation—has been materialized in the following way. Steam of 853 lb. pressure is generated in a drum placed at the top of the firebox. The latter is composed of a series of water tubes, the lower ends of which are connected by a foundation ring, while the upper ends merge into horizontal pipes, also called steam collectors, which are connected with steam coils placed in the water space of the upper drum. The firebox tubes with their foundation ring, the steam collectors and the coils form a closed system separated from the water in the drum. The former is filled with distilled water, the latter is fed with water from the tubular boiler. The distilled water is heated in the firebox and steam of a pressure varying between 1,100 and 1,300 lb. per sq. in. is generated. In passing through the coils this ultra-high pressure steam transmits its heat to the water in the drum and evaporates it into steam at 853 lb. per sq. in. gage pressure. After having given up its heat, the ultra-high pressure steam condenses and returns back to the tubes where it is again evaporated, and so on. The distilled water serves only as a medium for the indirect heat transmission from the firebox to the water in the drum. No scale or mud of any kind can collect in this closed circuit of distilled water.

The high-pressure steam generated in the drum passes through a superheater placed in the fire flues of the tubular boiler, which is heated with gases leaving the firebox as in ordinary boilers. The moderate-pressure steam (199 lb. per sq. in.) generated in the tubular part passes through another superheater also placed in fire flues.

The ultra-high pressure locomotive was rebuilt by Henschel & Son, Cassel, Germany, from an existing 4-6-0 three-cylinder simple-expansion passenger locomotive (Class S10[2]). A new inside high-pressure cylinder was placed between the frames, and 11 7/16 in. was chosen for its diameter. The outside cylinders were left unchanged; they had a diameter of 19-11/16 in. and were made low-pressure cylinders. The stroke of all three cylinders remained 24 13/16 in.; the diameter of driving wheels is 78 in. The cylinder volume ratio is 5.94. The rated tractive force is 33,400 lb.; this corresponds to a mean effective pressure, referred to the two outside cylinders, of 272 lb. per sq. in., or to a boiler pressure factor of 31.9 per cent. This is rather high for expansion in cylinders with a volume ratio of almost six. An explanation of this will be given later.

The locomotive was completed in 1925 and since then has been in experimental service on the German State Railways. Very elaborate tests made in Germany showed at full power a steam consumption of 15.6 lb. per drawbar horsepower-hour behind the tender.[12] The minimum coal consumption per same unit was obtained

[9] These data became available through the courtesy of G. S. Edmonds, superintendent of motive power, Delaware & Hudson.

[10] Hochdruckdampf bis 60 atm. in der Kraft-und Wärmewirtschaft by O. H. Hartmann. Zeitschrift des Vereines Deutscher Ingenieure, 1921. No. 26. p. 663.

[11] Mechanical Engineering, 1926, pp. 1200-1201; *Railway Mechanical Engineer*, January, 1927, pp. 4-6, and The Engineer, January 20, 1928, pp. 81-82.

[12] The Engineer, January 20, 1928, p. 80.

at approximately half power and amounted to 2.25 lb., this corresponding to 8.86 per cent overall efficiency. Per indicated horsepower-hour the steam consumption amounted to 13.4 lb.

Comparison of these figures with test results available from German road tests with other locomotives of the same class shows a saving of at least 20 per cent in coal, in favor of the Henschel-Schmidt high-pressure locomotive.

The described high-pressure locomotive is not the only attempt of this kind now being made in Europe. The Swiss Locomotive Works, Winterthur, are engaged in building a high-pressure locomotive of a different type. The boiler is of a novel design and will carry only one pressure of 850 lb. The engine is a separate unit consisting of several unaflow cylinders, designed to run at a maximum speed of 1,200 r.p.m. The shaft of the engine is geared to a jack shaft connected to the driving wheels by means of gears.

The Schwartzkopff Locomotive Works of Berlin is developing a 2,500-hp. locomotive with a boiler designed by Professor Loeffler, in which saturated steam of 1,500 lb. per sq. in. is generated by introducing highly superheated steam of moderate pressure into heated water. The high pressure saturated steam is afterwards highly superheated.

The Maffei Locomotive Company, Munich, Germany, which built the turbo-locomotive described in Part 1, is now building another locomotive ordered by the German State Railways, equipped with a Benson boiler which generates steam at water's critical pressure and temperature; viz., about 3,200 lb. per sq. in. and 706 deg. F. For practical purposes the steam will be expanded to about 2,500 lb. per sq. in. and superheated afterwards. The locomotive will have a high-pressure and low-pressure turbine, and a condenser.

The Krupp Company is developing for the German State Railways a turbo-locomotive with a pressure of 850 lb. per sq. in., and a condenser. The locomotive will have one high-pressure and two low-pressure turbines, of which one low-pressure turbine will be used for speeds of 31 m.p.h. and over, and the other for speeds below 31 m. p. h.[13] In this way the turbines will be used at more appropriate speeds resulting in higher efficiencies, and the disadvantage of a direct connection between the turbine and driving wheels, indicated in Part I, will be partly eliminated.

Efficiency of high pressure steam

Before closing it would be well to touch upon several points which have a bearing on the efficiency of high-pressure steam and the type of engine and boiler which can be used in connection with it.

The higher the pressure, the higher the water and saturated steam temperature. At 250 lb. per sq. in. gage pressure the temperature is 406 deg. F.; at 850 lb. per sq. in. the corresponding temperature is 528 deg. F., a difference of 122 deg. A higher water temperature means also a higher smokebox temperature and consequently a greater loss of heat carried away through the smoke stack. Unless the extra energy in the exhaust gases is utilized, for instance, for air preheating (so far no practical design of an air preheater for a powerful reciprocating locomotive has been developed), this loss would represent a 3 per cent decrease in boiler efficiency. The higher superheat may also require a higher gas temperature, and, therefore, at least three per cent should be deducted from the saving resulting from the use of high pressures.

However, this applies to high-pressure boilers with only one pressure. The ultra-high-pressure boiler of the Schmidt Company should not have this disadvantage, as the pressure in the second and last part of the boiler is only 199 lb. per sq. in., and the ultimate gas temperature may be fairly low. Likewise, the application of an air preheater, or an economizer may result in at least maintaining, or even in increasing the boiler efficiency.

On the other hand in the two-pressure boiler only part of the working steam has high pressure (853 lb.), the other part being of moderate pressure (199 lb.). The efficiency of the engine will therefore, be less than it would have been, were all the working steam of ultra-high pressure. Thus a gain in boiler efficiency is obtained by sacrificing part of the gain in engine efficiency.

Compounding with high pressures

Another point which must be considered in employing high pressures is the necessity of compounding the engine. In order to benefit from the advantages of high pressures, a fairly high number of expansions must be provided. Lawford H. Fry estimated the thermal efficiency of a locomotive engine cycle at various pressures and numbers of expansions, and plotted a curve as shown in the chart.[14] Assuming that the admission temperature is 650 deg. F. and gage back pressure 10.3 lb. per sq. in., there is practically no improvement in efficiency by raising the pressure from 200 lb. to 800 lb., if the number of expansion is below two, or from 350 lb. to 800 lb., if below three, and so on. In order to get all the benefit of a 850-lb. pressure which would justify the complication of a high-pressure boiler and engine, it is necessary to employ a ratio of expansions of at least 9 to 10, or even 12, if possible. We saw that the German ultra-pressure locomotive had a cylinder volume ratio 5.94, almost six. Thus at 50 per cent cutoff in the high-pressure cylinder a ratio of expansions of 12, and, in accordance with the above chart, a theoretical engine efficiency of about 21 per cent, would seem to be possible. A ratio of expansion of 12 would be out of the question in a simple engine, even with poppet valves, and, furthermore, the piston thrust which would result in a simple engine from the total boiler pressure on a piston of a size required for such an expansion ratio, could not be considered in a locomotive. Thus a compound engine with a high ratio of expansion must be employed; but this in a compound engine means large cylinders and a reduced mean effective pressure, which cannot be chosen arbitrarily, as on this depends the value of the rated tractive force of a locomotive.

It is often thought that higher pressures permit obtaining larger tractive forces. This is true only if locomotives of the same type, either simple, or compound, are compared. But if we deal with a simple engine and consider raising the pressure to a figure when compounding becomes necessary, then unless we go to very high pressures and choose the ratio of cylinder volumes accordingly, we may not gain anything in tractive force. So, for instance, a 250-lb. pressure two-cylinder simple-expansion locomotive has a maximum mean indicated pressure of .85 x 250=

[13] Organ für die Fortschritte des Eisenbahnwesens, December 30, 1927, p 523.

[14] High Steam Pressures in Locomotive Cylinders by L. H. Fry. Paper presented before the spring meeting, A. S. M. E., 1927. Abstracted in the *Railway Mechanical Engineer*, August, 1927, p. 527.

212 lb. per sq. in. The three-cylinder compound locomotive No. 60,000 with 350 lb. boiler pressure and a compound engine with a ratio of cylinder volumes of 1:2 showed at the test plant a maximum mean indicated pressure, referred to low pressure cylinders, of 203 lb. per sq. in. (58 per cent of boiler pressure). The Horatio Allen, which has the same boiler pressure (350 lb. per sq. in.) and a compound engine with a cylinder volume ratio of 1:3.04, showed on road tests a maximum mean indicated pressure, referred to the low-pressure cylinders, of only 192 lb. (54.8 per cent of boiler pressure)—the slight drop in mean indicated pressure, as compared with the locomotive No. 60,000, is due to the higher cylinder-volume ratio which may be better from the point of view of engine efficiency (see the chart), but gives a smaller mean indicated pressure. The Schmidt untra-pressure locomotive has a maximum indicated pressure of 272 lb. per sq. in. (31 per cent of the boiler pressure), and this for the reason that the engine is not of the pure compound type, because a certain amount of moderate-pressure steam is added to the steam from the high-pressure cylinder on its way to the low-pressure cylinders. If it were not for this, the mean indicated pressure would not be over 190 lb. per sq. in. (22.4 per cent of the boiler pressure). Thus we see that the high-pressure compound locomotives have more or less the same mean effective pressure as the simple moderate-pressure engines, and, therefore, comparing a two-cylinder moderate-pressure simple-expansion locomotive with a three-cylinder high-pressure compound locomotive with two low-pressure cylinders of a size equal to those of the two-cylinder simple locomotive, the tractive forces of the compound locomotives cannot be increased notwithstanding the fact that the latter locomotives employ pressures from 1.4 to 3.4 times higher than the simple locomotives, and that they have in addition an extra high-pressure cylinder. Consequently, if higher tractive forces are required, two cylinders larger than in a simple locomotive must be provided in addition to an extra high pressure cylinder, or, if this is impossible, the cylinder volume ratio must be reduced and part of the economy due to the high pressure will be sacrificed.

Here again, as in the case with the boiler efficiency, the Schmidt two-pressure locomotive, being a compromise between a compound and a simple engine, has the advantage of a simple engine with respect to higher mean indicated pressure. For locomotives with cylinders near the permissible limits of size and piston thrust, a two-pressure, so to speak, semi-compound locomotive can give a larger tractive force than it would be possible to obtain from a high-pressure locomotive with a pure compound engine.

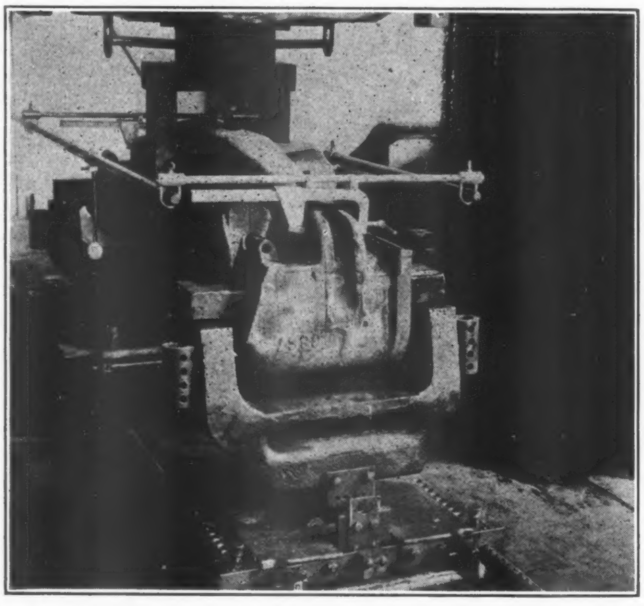
The remark made in reference to the tractive force of a high-pressure locomotive should not be confused with the horsepower of such a locomotive. The maximum output of a locomotive which can be obtained at some fairly high speed and which depends upon the evaporation capacity of the boiler, will undoubtedly be increased in the high-pressure locomotive in view of the better engine efficiency, provided a boiler of the same evaporation capacity can be used. Where the question of maximum tractive force is of lesser importance, where a great pull is required only at starting, and where this can be well accomplished by using a booster, and where, on the other hand, economy and horsepower are more important, the high-pressure locomotive will be found economical and useful.

This is the present status of various attempts which are being made to increase the efficiency of our hundred-year-old locomotive and extend to it a new lease of life in the struggle with her rivals, the middle-aged electric locomotive and the young newcomer, the Diesel locomotive. The remarks with respect to the possibilities of the turbine locomotive with condensers, and of the high-pressure reciprocating locomotive have been made not with any idea of criticism, but in order to show the different points from which the questions should be viewed. The experience with the locomotives described in the article, both in this country and abroad, will help to indicate the direction of possible progress of the steam locomotive.

Eliminating errors in truck side deflection tests

FREIGHT car truck bolsters and side frames were all of the "built-up" type until steel foundry methods were improved to such an extent that these built-up members could be integrally duplicated in cast steel.

The cross section of members in the earlier type of steel bolster and side frame resembled that of a beam or angle, while that of the type now in general use, more nearly conforms to the box or U-section, which shape



The apparatus in position while testing a truck side frame

is more favorable to a uniform rate of cooling while in the mould, thereby preventing shrinkage cracks, spongy metal and the localizing of stress under load in service.

During the development of these steel bolsters and frames, many physical tests were made to determine just where the metal should be located to do the most good. A check on the calculations determining the design is made by deflecting the test member, the amount of deflection being shown by gages, generally of the dial type, which are secured to bars supported at each end by extension arms projecting outward from clamps fastened to the frame or bolster at points between which, relative to a third clamp, the greatest variation in distance takes place while the load is being applied and removed.

While tightening and loosening the clamp screws, the extension arms on the clamp will move up and down, as shown in Fig. 1, similar to the wings of a bird in

flight. Therefore, it is important that nothing occur to change the width of opening between the jaws of the clamp while the test is being made.

While testing the earlier type of bolster or side frame with the beam or angle section, the width of opening between the clamp jaws remains fixed because there is a solid block of metal between them, but at the same clamping position on practically all of the latter models there is a box section, the walls of which will undergo a diaphragmatic movement, shown in exaggeration in Fig. 1, while the load is being applied and removed.

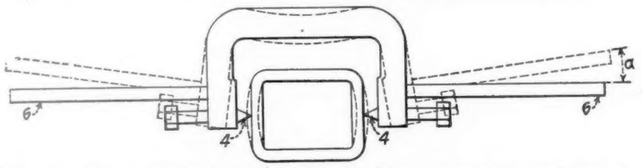


Fig. 1—The conventional type of clamp used in making deflection tests on side frames and bolsters

In so far as the clamp is concerned, the deflectometers will remain in their fixed position and show no error when held by the older type clamp, provided the metal between the jaws is solid, but when clamped to a box section they will introduce an error in the test results. To eliminate this error, a set of clamps has been developed by P. J. McCullough, a member of the engineering staff of the Scullin Steel Company, with an auxiliary clamp secured to the main clamp directly over each of the contact points of the main clamp screws. In this position, no vertical movement of the auxiliary clamps is caused when the opening between the jaws of the main clamp varies during the test.

As these relatively immovable auxiliary clamps hold the crossbar, which takes the place of the extension arms on the older type clamp, there can be no error re-

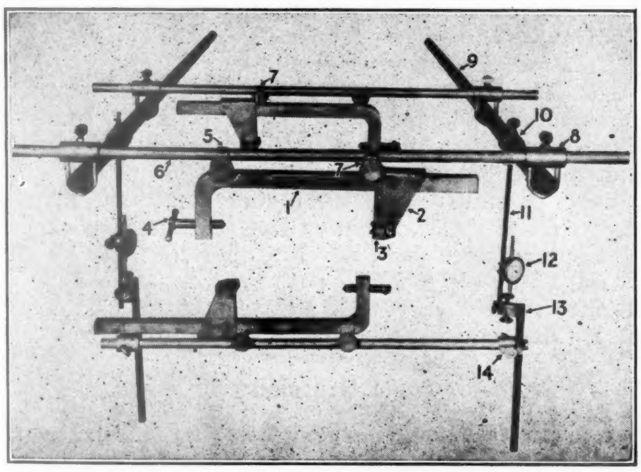


Fig. 2—Clamps devised to eliminate errors when making deflection tests on truck frames and bolsters with box sections

sulting from the movement of the side walls of the box section while the test is being made.

The frame supporting the dial gages consists of three snap type ratchet clamps: (1), Fig. 2, composed of a sliding jaw (2), swivel equalizing block (3) with a two-point contact, an adjusting clamp screw (4) with a vise handle, an auxiliary trunnion clamp (5) to flexibly hold the crossbar (6), an auxiliary clutch clamp (7) to hold the cross-tie-bar (6) against vertical movement without resistance to its reciprocating "creep" which is forced by the opening and closing of the main clamp jaws when the box section test piece deforms under load. The three cross-tie-bars are held by the auxiliary trunnion clutch clamps, four cylindrical clamps (8) with a V-loop parallel bar support. The additional parts consist of two parallel bars (9) with fiber protectors at each end. A blade trunnion at one end rests in the notches of the loop on (8) to prevent rotation of the parallel bars. The two cylindrical clamps (10) hold the gage bars (11). The two gages (12) are supported by the two adjustable plunger supports (13). The two double bar clamps (14) connect parts (11) and (13).

Fig. 1 shows the conventional type of clamp used in making deflection tests on side frames and bolsters. The distance *a* indicates a magnified amount of relative change taking place in the position of the end of arms (6) when the load is being applied to the test piece which will undergo change in width between the clamp screw points (4) provided the test piece is of box or U-section.

If this type of clamp were used in place of those shown in Fig. 1, the false movement as indicated by the dotted lines at *a* in Fig. 1, would be communicated through (8), (9), (10), (11) and (13) and register on the dial gage (12).

Relation of the air brake to slack action*

Contributed by the Pittsburgh Air Brake Club

THE factors entering into the production of shocks in long trains, by the making of brake applications, are:

1—Amount of and rate of developing braking force at the head end of the train; amount of brake application, brake pipe leakage and piston travel.
2—Throttle manipulation.
3—Track condition, as to grade and curvature.
4—Speed.
5—Free slack between cars.
6—Type and condition of draft gear and attachments.

All factors being the same, the amount and rate of braking effort developed on the head end of a train in advance of that developed on the rear determines the difference in impact velocity created when the slack runs in, and, therefore, the severity of the resulting shock. When the brakes are applied from the locomotive, they apply serially from the head end toward the rear end which results in the head end being retarded first. The time of serial application is a little shorter with a heavy reduction than a light one, but nevertheless the retardation set up on the head end is greater in proportion as the initial brake application is heavier. It is for that reason that the split reduction is so generally resorted to in order to allow the slack to close in and adjust itself gradually.

Importance of brake pipe leakage

Brake pipe leakage is a highly important and most serious factor in increasing the rate of developing retardation and, therefore, in causing shocks. Naturally the more leakage the less control the engineman has over the rate and degree of brake pipe reduction and particularly in the front portions of trains. Thus, differences developed in the retarding force between the front and rear will be greatly increased. This is one of the best reasons for keeping brake pipe leakage to the lowest possible figure since it is one of the factors that can most readily be controlled.

Variations in piston travel varies the retarding force developed with any given brake pipe reduction so that

* Abstract of report presented at the thirty-fifth annual convention of the Air Brake Association, Detroit, Mich., May 1 to 4, 1928, inclusive.

in extreme cases it may be the cause of bad slack action in the train. This cause is, of course, beyond the control of the engineman and no change in service brake manipulation can fully overcome it, particularly, where combined with heavy brake pipe leakage. The recent change in the A. R. A. specification for piston travel from 6 inches to 8 inches, to 7 inches to 9 inches will be highly beneficial if it is carefully observed. This change clearly makes for a more flexible and smoother brake for level road service. Contrary to the belief of many, it makes for better flexibility and equal safety for grade service.

There is usually a critical speed for a given set of conditions as to train make-up, brake pipe leakage, road bed, etc., where shocks, due to slack action, will be the maximum. This is usually a fairly low speed and it should be the practice under such speeds to handle the brake with great care. For the critical condition, the head end will be just brought to a stop at the instant the slack closes in at the rear. When the speed is lower than this critical point, the energy in the train is less and results in reduced shock as compared with the critical speed. On the other hand, if the speed is higher, the retardation at the head end will be at a lower rate, due to lower brake shoe friction, and consequently the shock will be less.

Other things being equal, the greater the amount of slack the higher the critical speed will be and the greater the possibility of damage due to shock. It may be said without question that the amount of shock possible to obtain, increases in severity in proportion to the amount of slack. Slack of itself does not create shock, but if there were no slack there could be no shock.

Recent investigations

During a recent investigation on an eastern railroad, it was found that in a train of 95 loaded coal cars, there was as much as 100 ft. of slack. In an investigation on another eastern road, it was found that the slack ranged from 49 ft. per 100 cars, as the best condition encountered and involving a train of comparatively new cars, to a maximum of 103 ft. The average for 14 trains, taken at random, was 70 ft. Of course, these figures for slack do not represent free or unresisted slack alone, because the measurement was taken by slackening a road engine back, then forward, with the rear end of the train anchored by a helper engine. Recently some 363 passenger cars in 31 different trains were investigated to determine the free slack existing in couplers and it ranged from ½ inch to 2⅜ inches per car. The average for all was 1.41 inches per car. On 100 of these cars, 31 per cent had one-inch free slack; 17 per cent had 1¼ inches; 11 per cent, 1½ inches. Only 25 per cent were less than one inch. On a few cars, the free slack at one end was ¾ of an inch and on the other end 2 inches. This was all free, unresisted slack. The total slack by bunching and stretching the train ranged from 2¼ inches to 6⅞ inches per car, and the average for all was 4.9 inches. It was noticeable that those trains having the greatest number of head end cars, such as baggage, express and mail cars, always developed the most slack.

No specified procedure for checking free slack

In view of the fact that neither the A. R. A. nor any railroad of which we know, has any rule or specified procedure for checking up and limiting the amount of free slack in draft rigging, it is obvious that this situation justifies serious consideration leading to definite corrective action. The 5⅛-in. limit between the knuckle and guard arm of the coupler head represents a 7/16-in. allowance from the 4 11/16-in. dimension given for the standard No. 10 coupler contour. This A. R. A. limit has been specified only to insure that couplers will remain coupled and has no direct relation to the question of free slack.

It has been argued that a certain amount of free slack is necessary to facilitate the starting of long trains, but certainly no one can take the position that as much free slack is necessary as represented by the foregoing figures; otherwise, those trains cited which have a minimum of slack are inadequately provided with free slack for suitable starting and, certainly, that contention has never been heard.

It is generally accepted that a friction draft gear of suitable design is much better protection against shocks than the older spring type gear; but, leaving out of consideration friction draft gears having a relatively low value when in perfect condition, many so-called friction draft gears are, on account of extended wear and lack of maintenance, offering but little, if any, better protection to the car than the ordinary spring gear. Others, because of being in a jammed condition, do not provide the protection that is characteristic of friction gears when properly maintained.

Of course, a large majority of the shocks experienced by the freight car occur during switching movements, and in these the amount of free slack is probably not of any consequence. The basic value of new gear and condition of the draft gear, however, is decidedly of consequence.

Recommendation

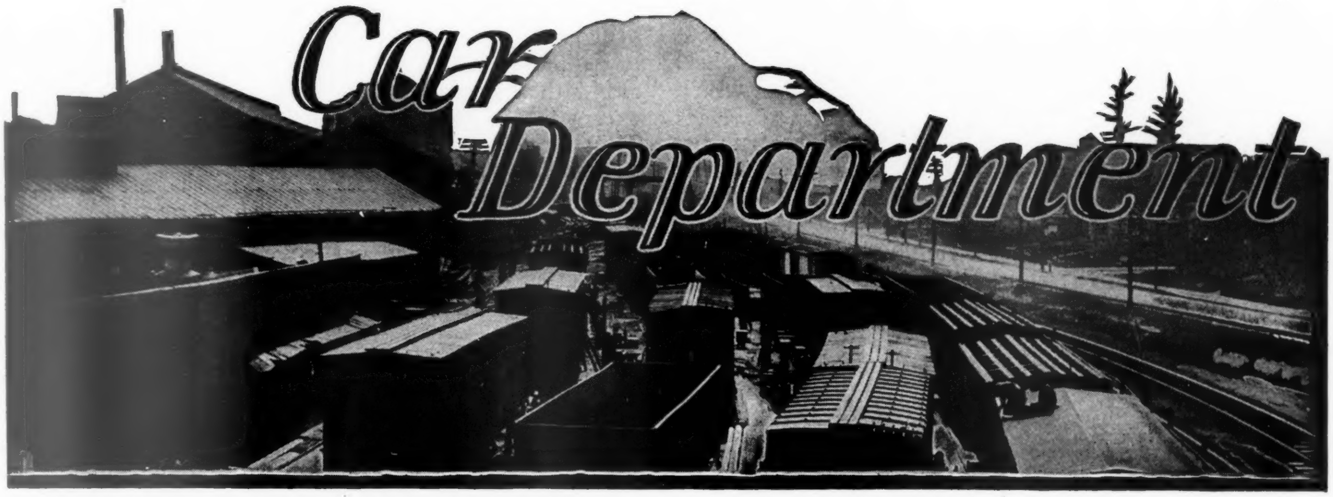
The condition of the draft gear and attachments on cars on repair tracks is generally an unknown quantity; better stated, just how bad the condition may be is unknown, for these parts get little if any attention.

It is recommended that this matter be referred to the A. R. A. with the suggestion that suitable rules for interchange be adopted which will define permissible limits of wear in draft gear and couplers and provide suitable periodic test specifications to insure the maintenance of these devices within these limits, and thereby secure a reasonable control of free slack between cars.

The report was signed by F. C. O'Neill, (Big Four); R. M. Long, (P. & L. E.); W. F. Peck, (B. & O.); R. Wolfe, (N.Y.C.); W. M. Nelson, (B. R. & P.); and R. I. Cunningham, (Westinghouse Air Brake Co.)

Discussion

One of the speakers stated that his road made up a test train of 115 cars, ascertained the brake pipe leakage and ran the train around a curve at a speed of from eight to ten miles per hour. The brakes were not applied during the test, but the train was controlled entirely by the use of the throttle. In this test, 11 cars were knocked off center which, he said, was due to slack action. However, when the train line was tightened up so that the brake pipe leakage was reduced to less than 3 lb., none of the cars in the train were disturbed. This train was made up with loads ahead and at the rear, with the empties in the middle. It appeared to be the consensus of opinion that draft-gear maintenance was as essentially a part of train handling and operation as maintenance of brake equipment. A number of speakers favored examination of the draft rigging, especially the friction gear, the condition of which cannot be determined by any visual inspection, at least, from the outside.



Repairing wheels on the Central of Georgia

Wheel shop at Macon, Ga., equipped to handle 1,400 pairs per month during busy season

By J. W. Rittenbery

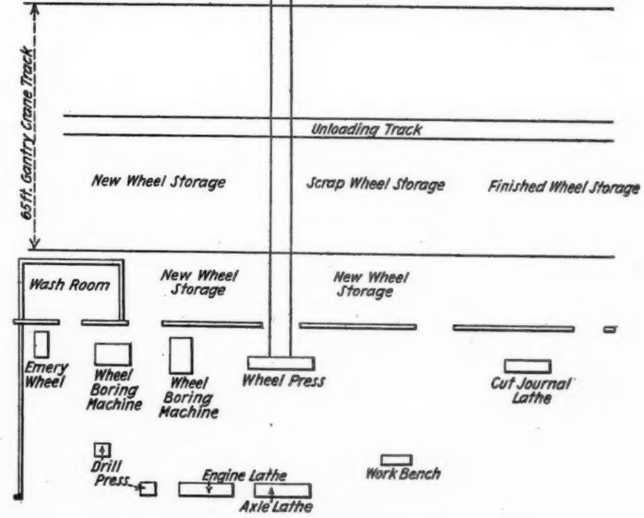
Wheel shop supervisor, Central of Georgia, Macon, Ga.

THE principal wheel repair shop of the Central of Georgia, located at Macon, Ga., supplies practically all of the wheels used on the system. Under normal conditions it fits up an average of 1,100 pairs of wheels per month, and during the fruit season as high as 1,450 pairs, 1,350 pairs being new and second-hand cast freight car wheels, and about 100 pairs being divided among steel passenger coach wheels, steel tender wheels, and rolled-steel and steel-tired engine-truck wheels.

Referring to the drawing showing the layout of the shop, the unloading tracks, used for wheels shipped in on cars as mounted scrap, are served by a Shaw 15-ton gantry crane which permits rapid unloading. The unloading tracks cross the wheel track. This arrangement enables the cars to be kept pulled up to the crossing so as to be unloaded with a minimum of crane travel, and then moved away from the crossing as fast as they are loaded or unloaded. The crane is frequently taking scrap wheels off the car and, on the return movement, loading new wheels to be shipped back, on the same car. In other words, the crane removes the scrap wheels, which are run into the wheel shop to be pulled, and picks up the new wheels and places them on the car on the spot from which the scrap wheel was removed. Scrap wheels from the wheel press are stored along the unloading track and loaded in cars with a crane magnet, an average of 300 being handled per hour. The storage space for scrap is adjacent to the wheel shop door near the wheel press, which enables the shop to handle scrap wheels rapidly.

Handling scrap wheels

Scrap wheels from the repair track are placed on the scrap wheel track and run down to the wheel shop for final inspection, which is made by the wheel press forces. All axles are sponged off and inspected for defects. The wheels are checked and if, when the symbol letter indicating the defect as marked by the car inspector, is found to be in error, we furnish a check slip to the A.

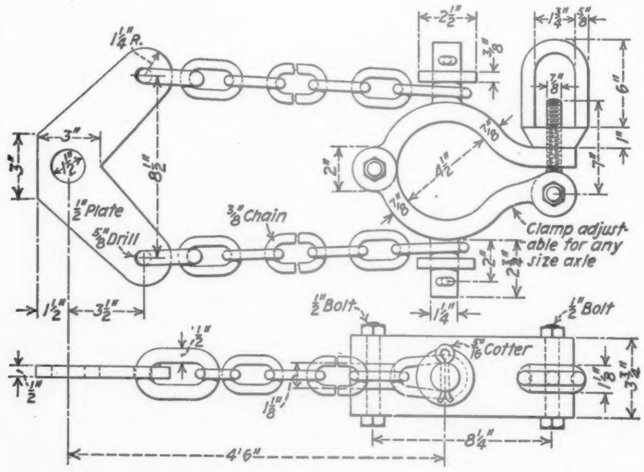


Layout of the tracks and equipment

R. A. clerk, correcting it. This system affords a double check on all wheels and axles. After inspection, the wheels are set on the wheel-press tracks, which are located at right angles to the scrap wheel tracks.

The tracks to the press consist of two overlapping tracks with the rails spaced 5 in. apart and running to

within 8 ft. of the press. The 5-in. spacing makes it impossible for the flanges of the wheels to nick or cut the journals on the adjacent pair of wheels. The wheel press is a modern Niles 400-ton double-end type, which enables the shop to pull an average of 25 pairs of wheels per hour, including inspection and routing wheels to the press. The location of the two tracks leading to the press makes it impossible to throw both pairs of wheels to the center of the press, each track being 3½ in. off center. To insure the wheels running central, a short piece of angle iron is spiked to the floor, and this is set at an angle of 30 deg. As the flange of the wheel



Sling for lifting axles

comes in contact with the angle iron, the wheel is automatically thrown into position in the press. The average mounting time for cast-iron wheels is 20 pairs per hour, the same press being used for mounting and dismounting.

Duties of the press operator and helpers

The duties of the press operator and his four helpers are, as follows: The man assigned to the axle cart paints the inside wheel bore and brings the axle to the wheel press. It is then caught in the axle hooks and swung from a chain hoist by one of the helpers, whose duty it is to draw up the axle on the chain hoist, paint the axle, and run one end of the press. By the time the axle is painted and ready, the two wheel rollers have brought up the wheels. The axle is inserted in the wheel bores and the hooks released, the two wheel rollers pushing the wheel into the press, gaging and then removing them from the press, when finished.

The press operator takes the number and date of each wheel and enters this on the Crosby indicator record opposite the pressure diagram. This data is taken while the axle is being inserted, and is transferred to the record while the next wheels are being brought up. The track, being practically level, permits the wheels to roll its full length when given a start from the press end, thus eliminating any delay on the part of the wheel rollers in getting the next pair of wheels to the press. The total time for this operation is three minutes.

Wheels are bored on an old style 48-in. Niles boring mill which was installed in 1903. The average output on this mill in an 8-½-hour day is 88 cast car wheels. All classes of wheels are bored on this mill, which also has a facing head for facing off the hubs of engine-truck wheels. Axles, the lengths of which have increased in excess of the ⅜-in. limit allowed by the A. R. A., are built up on the collar by oxyacetylene welding, bringing them back to their original lengths when turned. Axles are turned on a Niles No. 3 heavy-duty axle lathe. This machine takes care of all axle work, except the engine-truck axles, which are machined on a 24-in. engine lathe. The machine also takes care of all hub liners.

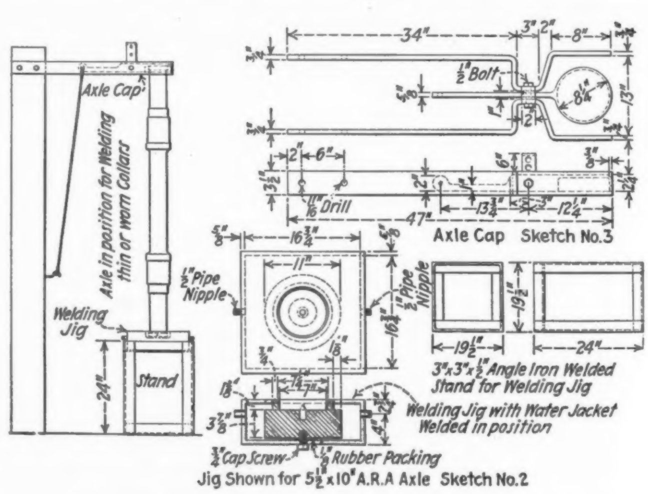
Wheels and hub liners are drilled and countersunk on a radial drill press in the wheel shop, the liners being made solid and riveted to the wheels with copper rivets. The lathes are served by a wall crane carrying an air hoist mounted on a ball-bearing roller carriage.

For dressing cut journals, the shop has a 44-in. Bradford lathe. The average time for dressing cut journals is 30 min. per journal. This lathe is served by a wall crane which is conveniently operated from the side of the machine.

New wheels to be bored are stored just outside the wheel shop where they are conveniently accessible to the two repair shops, with a door opening into the storage space which is located between the shops.

Reclaiming axles

Reclaiming axles with thin or worn collars is accomplished by the use of an oil preheating furnace, which accommodates two axles with one heat. After heating, the axle is swung into an upright position with the wall crane and chain block, using the sling shown in one of the drawings. The turn buckle allows quick adjustment around the axle center. The axle is then swung over the welding jig also shown in one of the drawings, and the cap is dropped on the axle to hold it in place. The axle cap is adjustable for different length axles and is shown in sketch No. 3 of the drawing. Welding of the collar consists of filling the space between the collar and the die block. The running water around the die blocks keeps the block cool and prevents the axle from sticking to the block. The die block is



Welding jig and axle cap for reclaiming axles

made tapered, to allow the finished axle to slip out easily. As the axle is rough when removed from the block, ⅜ in. of stock is allowed on the diameter which, when removed, gives a neatly finished job. The actual welding time on collars runs an average of seven minutes per collar, using two operators. This is not an average finishing time; the finishing time on 80,000-lb. axle collars is averaging 32 collars in an eight hour day. This includes preheating, handling, and all necessary work in connection with the welding.

N. C. & St. L. paint shop at Nashville

An interesting feature of the work is the extensive use of lacquer and the maximum utilization of the spray for all painting

THE Nashville, Chattanooga & St. Louis first made use of the spray gun for passenger car painting in October, 1925, and the early experience with this type of paint application was sufficiently successful that it led to the almost complete adoption of this equipment for painting passenger and freight cars and the tenders, cabs and jackets of locomotives. At about the same time experimental work was carried out with the use of nitro-cellulose lacquers for the finishing of steel passenger cars, which has since led to the adoption of this finish for that class of equipment as well as for locomotive finishes. Over a period of more than two years, during which time the equipment has been in regular service on the road, there are indications that this type of finish is more durable than those formerly used, and that it has the additional advantage of a material saving in the time required for application in the shop.

Exhaust equipment for use when spraying car interiors—(Left) The fan and dummy end door; (Center) The vent duct, outside the shop, placed between sliding doors and opening filled in; (Right) One shop door open, showing the arrangement in the end door of the car

Paint shop facilities

The paint shop at Nashville, Tenn., which is the company's principal repair point, while not a new shop, is modern in its equipment and it has not been found necessary to make radical changes in the facilities in order successfully to apply lacquers by means of the spraying method. The shop building is a steel and brick structure approximately 90 ft. by 200 ft. There are 10 tracks leading into the shop from a transfer table, each with ample working room for the longest passenger car in service. At the present time only eight of these tracks are used for working tracks the remaining space being used for sash and door finishing, drying racks and for a curtain refinishing department. The shop roof is fitted with glass skylights, affording an abundance of natural lighting. The shop is equipped with an indirect heating system with two outlet pipes between each two working tracks. There are two large exhaust fans located in the end walls of the building for the removal of excess spray or odors.

The entire shop is provided with a unique design of adjustable scaffolding the uprights of which rest on the floor and the tops of the posts fit into pockets in overhead cross timbers. These uprights are adjustable laterally so that the scaffolding may be placed at any desired distance, within certain limits, from the side of the car. When a workman is standing on the floor painting the bottom stretches of the car the scaffold may be pushed back out of the way by one man. The horizontal walkways are adjustable vertically by placing the brackets in notches in the uprights which are located at intervals of six inches. Three men can handle the raising or lowering of the scaffold without difficulty. There are seven upright posts for each side of each car, two of which have sway braces to steady the entire scaffold when men are walking on it.

There is in use an ingenious arrangement for exhausting the interior of a car while being sprayed. It consists of a dummy end car door in which is mounted a 16-in. exhaust fan which draws the air from the inside of the car and sends it out through a ventilating duct fitted in a special support mounted in the outside doors of the shop. In this manner the excess spray or odors are removed to the outside atmosphere. This special exhaust equipment is mounted at the end door of the car nearest the transfer table doors. Another piece of interesting equipment for interior car painting is a set of portable lights shown in one of the illustrations. These consist of several lengths of conduit with suitable outlets for the attachment of sockets and connector plug cord so that the overall length of the portable light bracket is sufficient to rest in the deck window openings

of the car and the end connection is attached to the suspended outlets outside the car. The center outlet shown in the illustration is for the attachment of an extension cord to be used in toilets or other places that are not illuminated by the large lights on the main

Portable paint-burning outfit which may be used by four operators—It operates on vaporized gasoline

brackets. One or more of the portable lighting sets may be used as desired and it has been found that their use has decreased the breakage of light globes.

One of the illustrations shows a shop-made paint-burning outfit for burning off the old paint from wooden passenger cars or other wooden surfaces. It was developed to replace the old type brass hand torches and does the work in about one-quarter of the time. The burning machine operates on vaporized gasoline at an air pressure of from 5 to 10 lb. per sq. in. The torch is made out of a piece of pipe with a wooden handle and a Street ell on the end to direct the blue flame down on the surface. The torches are connected by suitable hose to the tank which is mounted on a truck used for transporting it from place to place. The equipment is so arranged that it may be used by from one to four operators.

In two other illustrations are shown two styles of racks, one for window sash and the other for doors. The sash rack is constructed of steel angles and has curtains suspended behind the sash to stop the excess atomized paint or varnish. The door rack is particularly interesting because it not only provides for a place to dry the doors after they are painted but enables the painter to mount the doors in a sliding carrier in such a way that they need not be touched while they are being painted nor until after they are dry. The illustration shows the construction of the rack, with one door on a carrier in the working position at the far end and the rest in the drying position out of the way.

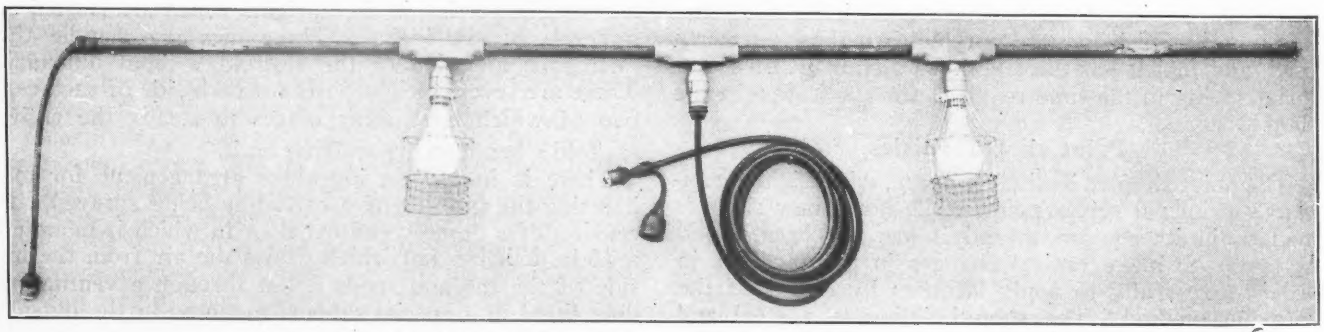
The use of the spray

On passenger equipment all outside coats, including primers, surfacers, body colors, color varnishes, varnishes and lacquers, are applied by the spray method. The same is true of locomotive tanks and cabs. Enamels, oil colors and varnish colors on the interior of baggage, mail and combination cars, and enamel on dining cars, kitchens and pantries, and on all steam pipes and guards in mail and baggage cars, are also applied by the spray method. In addition to the above major painting operations, color varnishes on all old-style window blinds in platform coaches, all classes of baskets for the inside of coaches, the seat irons, toilet seats, toilet paper racks and black or yellow enamels on tail or marker lamps or switch lamps are sprayed on.

The most recent extension of the use of the spray method is to refinishing pantasote curtains used in coaches.

The use of the spray has resulted in a substantial saving in labor costs as well as a considerable saving in time. As an example, one operator can apply varnish on two passenger coaches, including the vestibules, sash and end doors, in a half day whereas it would take six painters to brush-paint the same surface in the same time. Purely as a test it has been found possible to spray one coat of varnish on a platform coach in 35 min. and on a vestibule coach, including sash and doors, in one hour.

A comparison of figures for two periods of 11 months each show that in 15 less working days in the latter period the same number of cars having general repairs were turned out of the Nashville coach paint shop than in the former period, at a total cost reduction of slightly over $6,000. During the first half of the first 11-month period there were 48 employees in the paint shop, including coach painters, helper apprentices, regular apprentices and helpers. This force was reduced to 39 in



A shop made lighting fixture for use when painting the interior of a car

the last half of the period and, during the last half of the second 11-month period, was further reduced to 30 men.

Scope of painting operations described

In describing the various classes of painting operations they will be considered in the following order:

(1) Lacquer applied to steel passenger cars
(2) Wooden cars refinished after burning off old paint
(3) Wooden cars refinished over old paint
(4) Lacquer finish applied to locomotive tenders
(5) Spray painting freight equipment

As previously mentioned, the application of lacquer and varnish has been extended to a variety of purposes, but for the purpose of this article the description will be confined to the foregoing major operations. It might be added that the application of lacquer to locomotive cabs and jackets is essentially the same process as will be described in connection with locomotive tenders.

Lacquer finish on steel passenger cars

On the first day in the shop the car is completely scrubbed with a mixture of soap and pumice, or with a suitable commercial cleaner. This operation consumes the time of six men for eight hours. The car is then allowed to dry thoroughly and on the second day the bad spots on the car are touched up with steel lacquer primer which is then allowed to dry. The touching-up operation requires one man for six hours. On the third day a coat of steel No. 2 surfacer is applied which is done by one man and takes six hours. The car is then allowed to dry over a 24-hr. period and then on the fifth day all spots that may require it are puttied. This operation is performed by one man and requires six hours.

On the sixth day the car is completely sandpapered with No. 0 sandpaper, dry. To do this, four men are employed and the total time required is seven hours. After this has been finished one man applies a spray-coat of flexible lacquer surfacer in one hour. This is allowed to dry over night and on the seventh day the surface is sanded lightly with No. 00 sandpaper. This is accomplished in two hours by four men, and then three coats of lacquer of standard Pullman color are sprayed on by one man with intervals of one hour allowed for drying after the completion of the first and second coats and before starting on the second and third coats. The entire spraying operation consumes the time of one man for five hours. On the eighth day the lettering is penciled on with brushing laquer, no protective coating being needed. After this is completed the car is ready to leave the shop.

While the exterior is being finished the interior of the car has been cleaned and thoroughly scrubbed, renovated and touched up where necessary. The steel parts of the car are lacquer finished and the wood arm rests are filled in with wood filler, shellaced, varnished and rubbed down. Mail and baggage cars are scrubbed on the inside and are first spray-painted with one coat of flat lacquer, followed by a coat of white lacquer.

The underframe and the inside of the car trucks are sprayed with No. 3 black car cement, while the outside of trucks and the wheels are sprayed with the company's standard truck color. The roof, after being touched up where necessary, is brush-coated with one coat of No. 1 car roof cement. The deck sash are painted with No. 3 car roof cement and the windows, after the glass panes have been coated with an emulsion of soap and whiting, are sprayed.

A rack with sliding carriers on which doors may be mounted for spraying and pushed in out of the way while drying

The old method

As a comparison of the sequence of operations and

time required, the following brief outline of the former method of finishing steel cars is given:

First day—Scrub
Second day—Dry
Third day—Touch up and apply primer
Fourth day—Dry
Fifth day—No. 2 surfacer
Sixth day—No. 3 surfacer, first coat
Seventh day—No. 3 surfacer, second coat
Eighth day—Putty
Ninth day—Sandpaper and apply third coat No. 3 surfacer
Tenth day—Apply two coats of color and letter
Eleventh day—Apply one coat rubbing varnish
Twelfth day—First coat finishing varnish
Thirteenth day—Final coat finishing varnish

The saving in shop time serves to increase the output capacity of the shop without material addition to the extent of the facilities.

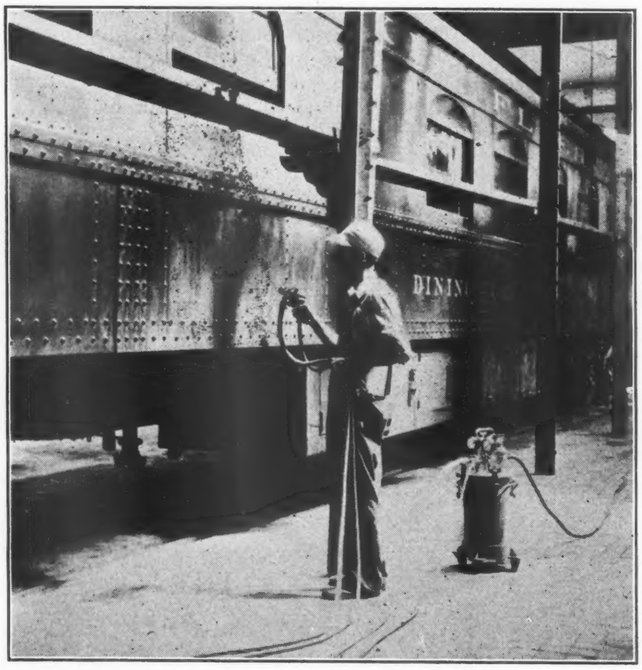
Refinishing wood cars

First the old paint is completely burnt off and the surfaces sandpapered. This operation takes four men 16 hours, so that the car is ready on the third day for the first coat of wood primer, which is sprayed on by one man in one hour. After this, 48 hours is allowed for drying.

On the fifth day one man sprays on one coat of No. 2 surfacer in one hour, after which 24 hours is allowed for drying. This operation is followed on the sixth day by a coat of No. 3 surfacer and another coat of No. 3 surfacer on the seventh day, the intervening time being allowed for drying. On the eighth day all nail holes are puttied and rough places glazed which requires the time of three men for eight hours.

On the ninth day the car is thoroughly sandpapered with No. 0 sandpaper. This is done by six men in five hours. After this is completed, one man applies one coat of No. 3 surfacer in one hour and 24 hours is allowed for drying. The car is then sanded down with No. 0 sandpaper by six men in three hours and one coat of flat car body color, standard Pullman color, is sprayed on in one hour and three hours allowed for drying before the second coat of color is sprayed on. After this another drying period of at least three hours is allowed before the lettering is penciled on with imitation gold. The lettering is done by one man in eight hours.

After the lettering is completed one coat of outside rubbing varnish is sprayed on and a 24-hour period is allowed before the first coat of finishing varnish is applied. This coat requires one hour to put on and 48 hours for drying, after which the final coat of finish-varnish is applied. The entire painting operation has required 15 shop days.



Applying lacquer to a dining car with the spray gun

The steel racks for spraying and drying window sash

On old wood cars, where the finish is put on over the old paint, the process is as follows:

First day—Car thoroughly scrubbed with soap and pumice
Second day—Sandpaper with No. 0 sandpaper, touch up with wood primer and spray on one coat of varnish size
Third day—Putty up bad places with lead putty

Fourth day—Sandpaper and apply two coats of flat color
Fifth day—Letter and apply one coat of finishing varnish
Sixth day—and
Seventh day—Allowed for drying
Eighth day—One coat of finishing varnish.

Tin roofs on wooden cars are protected with No. 3 car cement; No. 1 car cement is used for old Mule-hide roofs (new Mule-hide roofs are not painted) and canvas preserver is used on canvas roofs.

Locomotive tenders

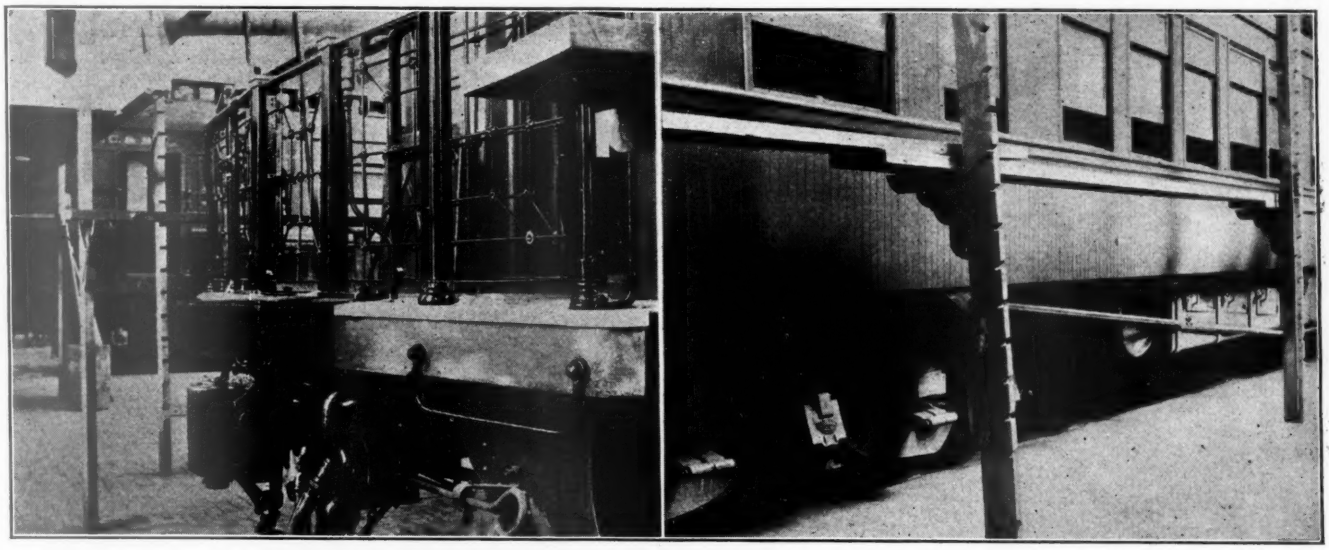
The following is the sequence of operations and the time required for refinishing locomotive tenders with lacquer:

WITH OLD PAINT REMOVED

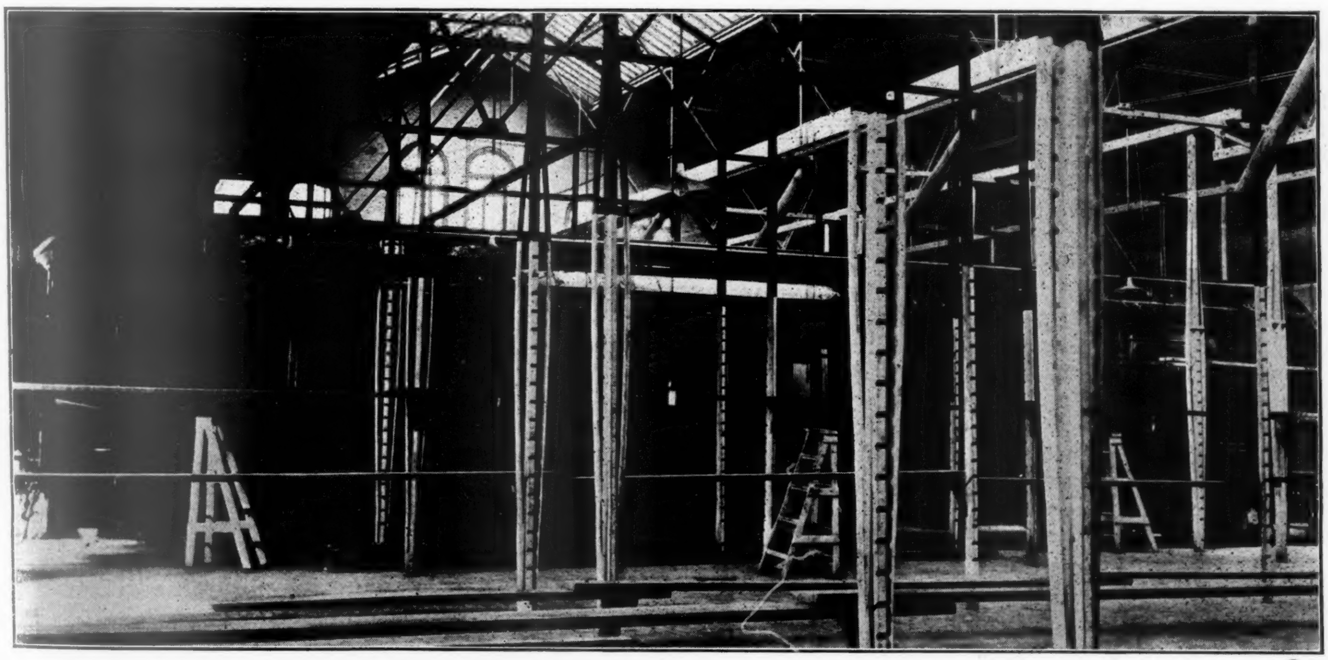
First day—Remove old paint with paint remover
Second day—Finish removing paint and apply one coat of steel lacquer primer
Third day—Allow to dry
Fourth day—Allow to dry
Fifth day—One coat No. 2 surfacer sprayed on
Sixth day—Puttied and glazed
Seventh day—Sand with No. ½ sandpaper
Eighth day—Apply one coat of No. 2 surfacer
Ninth day—Apply one coat flexible surfacer
Tenth day—Apply three coats of black locomotive lacquer
Eleventh day—Letter with brushing lacquer

REFINISHING OVER OLD PAINT

First day—Scrub thoroughly with soap and pomice
Second day—Sand with No. 00 sandpaper
Third day—Touch up with lacquer primer
Fourth day—Allowed for drying
Fifth day—Spray one coat of flexible lacquer surfacer
Sixth day—Spray three coats black locomotive lacquer
Seventh day—Pencil on lettering with imitation gold lacquer



Side and end views of wood car which has been finished with lacquer—This is a test application



The interior of the Nashville paint shop showing the special scaffolding

Freight car painting

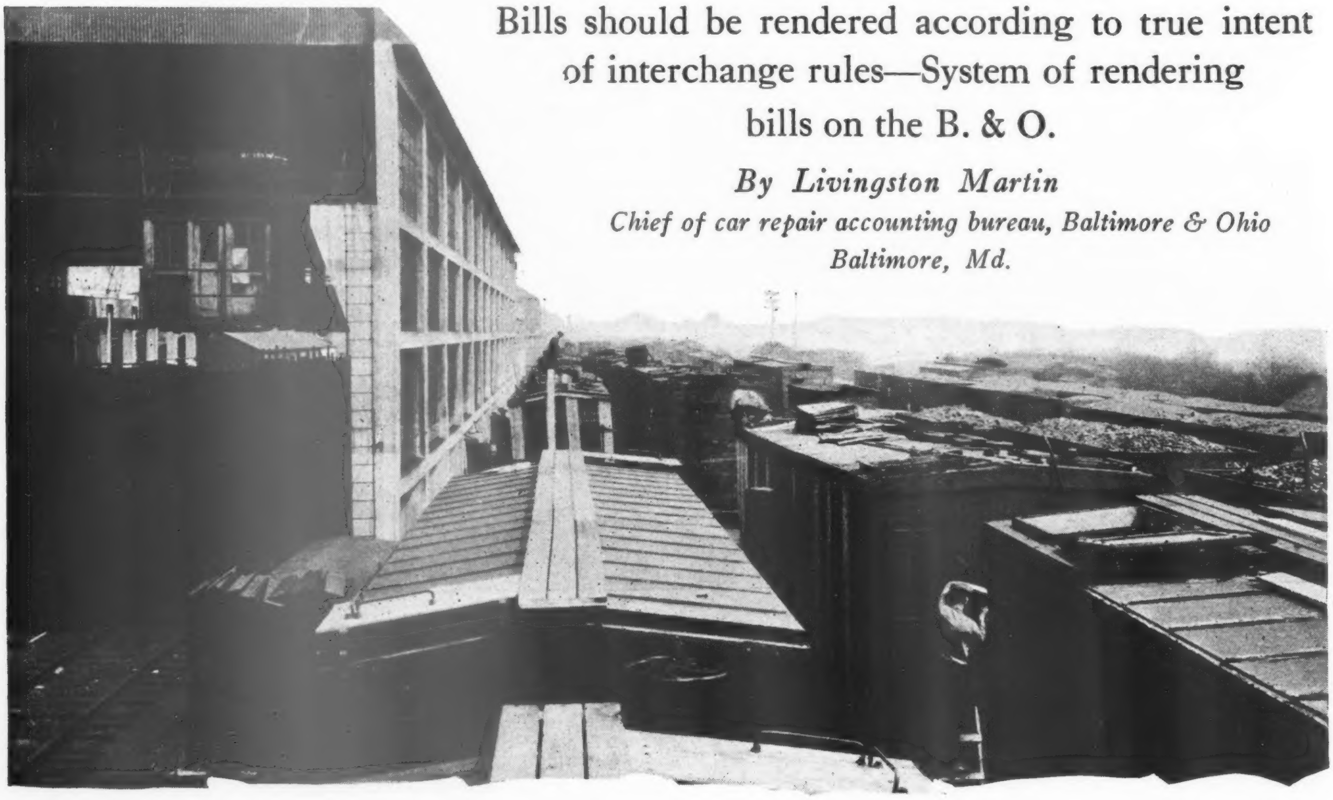
All wood box cars and gondolas have the wood parts spray-painted with two coats of freight-car red mineral paint. The underframes and trucks are not painted. Composite cars have the body and the underframe sprayed with two coats of black No. 3 car cement. The trucks are not painted. Steel hopper and gondola cars have the superstructure and underframe spray painted with two coats of black No. 3 car cement.

Handling car repair bills*

Bills should be rendered according to true intent of interchange rules—System of rendering bills on the B. & O.

By Livingston Martin

Chief of car repair accounting bureau, Baltimore & Ohio
Baltimore, Md.



NOT so many years ago, when the labor rate for car repairmen was 24 cents per hour and material costs were correspondingly low, the billing for car repairs under the American Railway Association rules was considered by many railroads as of minor importance in its effect on operating expenses and very few roads made any special effort to train car department employees in the application of interchange rules.

That condition, as well as all other conditions, changed during the World War, and the increased cost of labor and material made it apparent to the management of railroads that special efforts must be made in all branches of railroading in order to reduce expenses to meet the requirements of the Government. Accordingly, the handling of car repair bills began to receive more careful attention with the result that all railroads now have especially trained forces handling this work. The bills, as a whole, are now handled more nearly in accordance with the intent of the A.R.A. Rules than ever before.

An excessive amount of correspondence

The fundamental principle of the interchange rules is the same today as it has always been—honesty. If we would all apply the golden rule, the duties of the Arbitration Committee would be considerably lessened, and the cost of handling car repair bills would be reduced particularly as to correspondence.

There is no doubt that the volume of correspondence pertaining to exceptions to car repair bills is greater today than at any previous time. Some billing departments apparently seem to feel that it is their duty to make every charge they render stick. This is commendable so long as the charges are made in accordance with the A.R.A. rules, but there seems to a tendency on the part of some to read into the rules that which is not written in them and in this manner they will hold the files open, sometimes to the extent that they grow to be inches thick. It appears that they are endeavoring to tire the party taking the exception and cause him to close the file. Too many exceptions are taken to minor charges where the cost of writing the letter is greater than the amount to be recovered. The cost of handling correspondence can be considerably reduced if the heads of billing departments will make a conscientious effort to apply the rules as written; if the party taking the exception will write it intelligently, pointing out the rules supporting it; if the party declining to allow the exception will write clearly his reason, calling attention to the rule supporting it and discontinue such replies as "Charge is correct." In other words, if all parties concerned will make an honest effort to apply the rules as intended the majority of files will be closed with two letters.

Importance of knowing handling-line defects

Protection against handling-line defects on cars in interchange is an item governed by the interchange code of rules which no road can afford to neglect. This item is one that the car foreman is directly responsible for, and he should personally give it the attention it deserves.

With the interchange inspector rests the responsibility of protecting the company from accepting equipment with handling-line defects, to see that standards are maintained and to keep a clear, concise record of all defective cars in interchange. This record is not only valuable in A.R.A. bill work, but is often called for in court procedure in personal injury and loss and damage suits. The interchange inspector is confronted

* Abstract of a paper read before the St. Louis Car Foremen's Association, May 1, 1928.

almost daily with different conditions, making it necessary that he thoroughly understand the interchange rules. Many interchange inspectors are located in isolated places and unless some special efforts are made to follow up the work they are performing and keep them posted in the application of interchange rules, they will naturally become lax.

For the above reasons, it is the duty of the supervision to satisfy themselves that the interchange inspectors are familiar with all handling-line defects as listed in Rules 32, 58, 59, 65, 68 and 84 and to see that they cause defect cards to be issued and attached to all cars in interchange with any defects listed in the above rules. I favor periodical examinations of inspectors, or the occasional sending out of questionnaires which will cause the inspectors to read the rules to obtain the correct answers.

You do not have to accept very many accident cars in interchange to pay the salary of an inspector and for that reason the car foreman should personally check cars coming into the shop with handling-line defects. The movement of such cars should be traced to see if the damage occurred on the home line or if they came through interchange in a damaged condition.

Rule 4 not thoroughly understood

Rule 4 is the most thoroughly misunderstood rule in the entire code. Particularly is this so at the large interchange points and it seems that some of the joint interchange inspectors are endeavoring to read into this rule interpretations which are not indicated in the rule as written.

Defect cards are being rejected at the point of receipt and issued at the point of delivery on cars in direct movement for identical defects and particularly is this so with respect to old defects. The rule is plainly written and means just what it indicates. Its reference to slight damage and the proviso (that of itself does not require repairs before reloading) was placed in the rules to discourage a former practice of roads requiring defect cards for slight damages that would not be repaired until the car was forced into shop by other defects. However, some interchange points are issuing defect cards for all slight damage, making it necessary for roads entering those points to require defect cards in order to protect themselves on the return empty movement of the car. This rule is so important to the railroads as a whole that there does not seem to be any logical reason why the large interchange points should not agree on a proper basis for applying the rule, as its present application is destroying the intended reciprocal qualities.

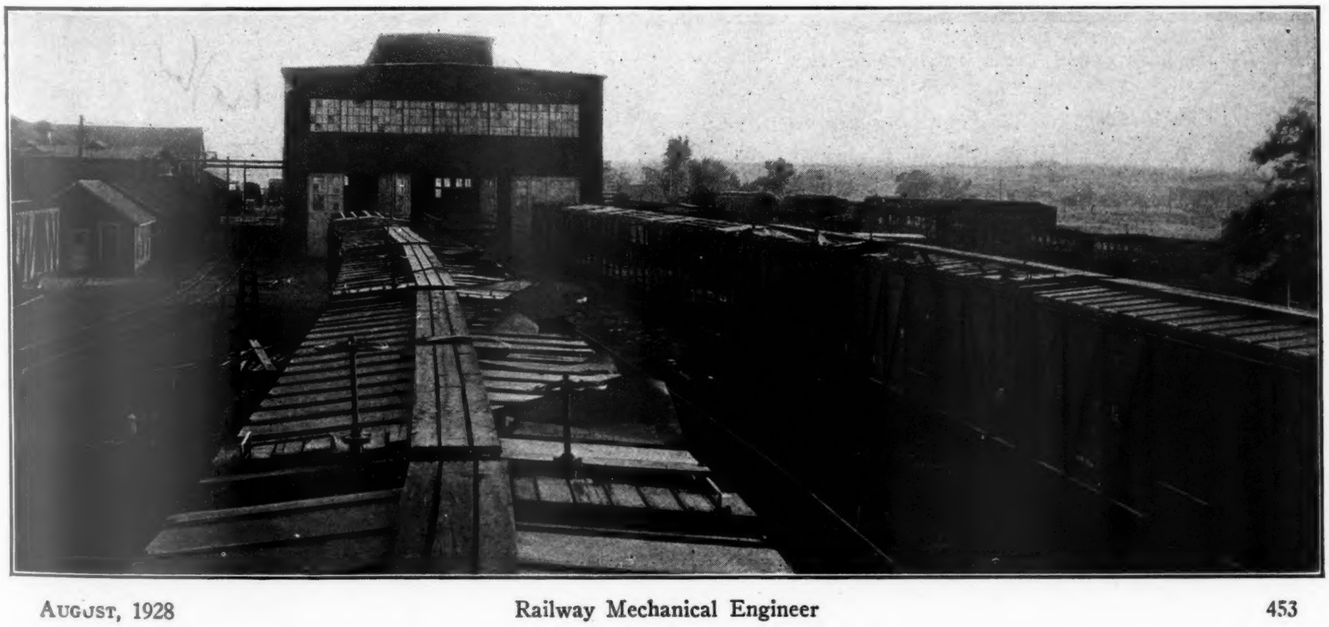
Local agreements at the various points are having their effect on the application of the rule. Local agreements that have been entered into at various points have their redeeming qualities in operation at a particular point, but I am wondering if proper consideration is being given to their effect on the country as a whole before they are adopted. A strict application of the American Railway Association Rules is preferable to local agreements as they affect the railroad systems of the country, in that all concerned have a common understanding. Particularly is this true in billing.

Defect cards

Rule 4 also requires that a defect card be attached to a car for all handling-line defects, and it is important that the defect card be correctly issued and that it list all the defects for which the handling line is responsible. While the only information required on defect cards, in addition to that required by the standard form, is an accurate list of the defects for which the handling line is responsible, if such defects are listed on the card in accordance with the locations shown in Rule 14 it will greatly assist the billing department in rendering correct credit bills and checking debit bills for errors. This is just as important as showing the location on repair records.

It is also of vast importance that the requirements of Rule 5, as it pertains to writing the defect card on both sides, be followed, as a card does not have to remain on a car very long, particularly in bad weather, before the exposed side will become illegible.

The rules require that a defect card be attached to the car at the nearest available inspection point. Some of us are lax in this particular, with the result that many cars are allowed to move into interchange points without defect-card protection or any other record to show that the handling line is responsible. Such practice is not fair to the joint interchange inspector, who must be governed by the rules in issuing cards. While most cars that have been in an accident will show physical evidence, some cars will not show such evidence. Some cars that have failed in ordinary train service and were not subject to any Rule 32 conditions may show physical indication of an accident, therefore, you are not



only unfair to the joint inspector in allowing cars to go to interchange without a proper record, but you are not carrying out the intent of the rules. Also, you are supplying conditions whereby erroneous cards may be issued, as it is not practical to hold cars at an interchange point until an investigation can be made, or you are interchanging cars without furnishing proper protection to the owner.

A duplicate copy of all defect cards should be forwarded to the billing bureau which should carefully examine them to see if they are issued in accordance with the rules. Particularly is this so in reference to Rule 88 where some cases of wrong repairs hold the repairing line responsible for labor only. Rules 88 and 122 list the items for which the repairing line is responsible for labor and material. For all other items the card must be marked "Labor only," otherwise the repairing road is permitted to bill for material also.

Another condition that we experience on the B. & O. is the failure of work checkers to remove defect cards from cars when repairs are made. Notwithstanding the fact that our instructions require the work checkers to examine all cars undergoing repairs for defect cards, we occasionally receive cards in the office bearing a notation that repairs were made at some other point. Such cases are thoroughly investigated as we feel the matter is important in that it may result in a loss to the company or an erroneous charge against the car owner; in fact we have had our attention called to such cases by the owner and while it may not indicate sharp practice on the part of the repairing line, it does indicate carelessness. Where carelessness exists, erroneous bills are sure to follow.

Repairing bad order refrigerator cars

No doubt some of the roads represented here have a number of cars stored awaiting condemnation. Examine those cars for defect cards, as bills can be rendered in accordance with Rule 94 for material as listed on the card on the dismantled cars. Following up this item may save your company considerable money in having the cars dismantled before the defect card becomes outlawed.

The original record of repairs is decidedly the most important factor in the correct rendition of car-repair bills; in fact, the Arbitration Committee considered it of such importance that it issued Supplementary Regulations effective January 1, 1924, dealing only with the preparation of the record, detailing the basic method of recording the repairs made, and supplied standard drafts of forms to be used in recording repairs, inspection, etc. A copy of the Supplementary Regulations should be available to each employe who originates records.

The regulations require that cars placed on shop tracks for repairs be inspected and a record written before the repairs are completed. From a shop operating standpoint, it is preferable to inspect and write the record before the repairs are started as it furnishes a guide for the repairmen and eliminates the necessity of a foreman personally designating or marking the repairs to be made. Another reason is that the record must show the cause for repairs. Most repair shops have a force engaged in picking up scrap and cleaning the yard and if the record is not written before the material is removed from the car, it is liable to result in assumed or erroneous causes shown on the record due to the removed material not being available for inspection.

The regulations also require that the record be checked with the repairs made on completion of the car and signed by the party making the final check. In case any repairs are made that are not listed on the record, they should be listed by the party making the final check, likewise if any items are listed that are not repaired, a line should be drawn through them before the party making the final check signs the record vouching for its correctness.

In addition to the standard information on a repair card, the form should require the date the car was built, the light weight, whether loaded or empty and the kind of trucks, as this information governs the charges to be made for certain items of repairs such as triple valves and couplers. Since the adoption of the standard car, the date the car was built indicates certain materials standard to the car without the necessity of stencilling the car to show these materials standard.

The party who writes the record must determine the responsibility for repairs and in case he is unable to decide if the owner or the handling line is responsible, the car foreman should make the final decision. Some cars have dual responsibility and such cars should be very carefully examined with a view of absolute fairness to both the owning and handling line and the record written separating the owning and handling line responsibility in such a way as not to be mistaken in the billing office, giving any specific reasons that may appear on the car for the separation.

The kind, full dimensions or actual weight of castings, forgings, structural and pressed-steel shapes must be shown on the record. Wherever it is possible I favor the showing of dimensions in preference to the actual weight. Work checkers usually carry a rule in their pocket, but they do not carry scales, and it is for this reason that the charges obtained through dimensions of material are more uniformly correct than otherwise. Besides, they furnish a basis on which the owner may check bills. Where lumber is used in repairs, the finished size must be shown on the record, to which the bill clerk adds allowances as per Rule 102 when pricing the bill.

The original record constitutes the foundation on which car repair bills are rendered and from the varied and vast amount of information that is required by the rules to be shown on the original record, it must be apparent to all that the correct rendition of car-repair bills

is efficient only so far as your method of educating employees in the preparation of the original records is efficient.

To meet the educational requirements, we maintain a direct contact between the billing office and the party writing the original records through our traveling inspectors. His first duty is to see that those employees writing original records are thoroughly acquainted with the requirements of the Supplementary Regulations as well as the rules.

To assist them in locating those employees who are not familiar with any of the requirements of the rules, we return all erroneous records direct to the inspector, who in turn personally calls on the party who wrote the record, calling his attention to the error and explaining to him the necessity of showing additional information, pointing out the specific rule that requires it. If you have any employees who will not improve under this system of education they should be replaced, as it is a strict requirement of the American Railway Association rules that records must be prepared according to regulations, and if you are rendering bills from records not so prepared you are not complying with the intent of the rules.

In view of the cost of educating employees to write correct records and the costs incident to improper information furnished, so far as possible the employees writing records should be kept on the job, except for promotion or inability to perform work properly.

Handling cars with extensive damages

Since the change in Rule 1 limiting the repairs to be made to foreign cars, it is the general practice of railroads to send home cars with extensive damage. However, it is just as important to place correctly the responsibility on cars sent home as it is if they are placed in the shop for repairs. Any cars damaged under Rule 32 conditions must either receive a defect card or be repaired and the record marked "no bill".

Rule 32 furnishes the dead line and any cars damaged under any of its provisions should be plainly marked on all records pertaining to the repairs. Before deciding the responsibility, all the circumstances surrounding the handling of the car should be fully developed and taken into consideration when making the decision.

Copies of all accident reports on the division should be forwarded to the car foreman and a complete file maintained in the car foreman's office. This file should be kept in loose leaf binders properly indexed according to file numbers.

In case accident cars are moved from one shop to another for repairs, a copy of the accident report should follow the car. In case accident cars are billed home for repairs, they should be properly defect-carded before allowed to depart, and the defect card should show the section of Rule 32 under which the damage occurred.

Before repair records or billing repair cards are forwarded to the billing office, they should be checked with the accident file, and the record marked accordingly to guard against improper charges. In case the division people subsequently learn, after the record has gone forward, that a car was in an accident, they should immediately notify the billing bureau. A copy of all accident reports should also be sent to the billing bureau, which must likewise check with the records to prevent erroneous billing for handling-line defects.

Some roads use the accident form in reporting disciplinary cases to the transportation officers. Where this practice is in vogue, due diligence on the part of the billing forces must be exercised to prevent records being marked "accident" when the cars were not actually damaged under any of the provisions of Rule 32.

As a further precaution against rendering bills for repairs to accident cars, we require our traveling inspectors periodically to check the accident file at all stations and report to the billing bureau any irregularities they find.

Rule 44 now provides a list of combination defects which make the handling line responsible unless it can furnish a complete statement to the owner as to just how the damage occurred. When such cars are repaired, the statement must accompany the bill and, where disposition is requested under Rule 120, the statement must accompany the request.

In view of the costs involved in repairing cars with combination defects, the true facts as to just how the damage occurred should be developed, and they should be developed immediately on the ground and with an open mind. The responsibility should be established in accordance with the intent of the rules without any regard as to the costs involved.

The proper application of Rule 44 cannot be followed up too closely by the billing bureau. We have found cases where the local people were over zealous in placing the responsibility on the owner and, vice versa, we have found cases where the car foreman, in his zeal to relieve his bad-order car report and to avoid holding cars for repairs, has reported it as destroyed, or handling-line responsibility with a view to securing disposition, when the opposite was the actual condition. Therefore, for the protection of both the handling and the owning lines, the traveling inspectors should make personal investigations of all extensively damaged cars.

A careful examination should be made by the supervision of all cars damaged to the extent of Rule 44 where a statement cannot be furnished, or damaged under the provisions of Rule 32 for owners' responsibilities. The rules provide that any worn out or broken parts on cars not damaged in connection with an accident may be billed against the owner. Therefore, if accident cars are sent home, the defect card should not include such parts and, if repaired, the record should plainly show those parts and in the case of broken material it should show whether they are old defects.

System of Rendering Bills

The Baltimore & Ohio handles its bills under what we call the consolidated system; that is, all work pertaining to the actual rendering of bills, including the writing of repair cards.

Original records are issued in duplicate by the aid of a carbon. The duplicate is filed at the repair point, and the original is forwarded to the billing bureau daily. System car-repair records received in the billing bureau, except those on authority of a defect card, are filed on receipt, while foreign car and authority of defect card records are counted and turned over to the bill clerks to prepare the bill.

The bill clerks write and price the billing repair cards, as per A.R.A. rules, in one operation, and a record is kept of the number turned out by each clerk per day.

In case additional information is necessary before the bill can be rendered, the original record is returned to the traveling man located in the district, and he personally takes up and explains to the employee originat-

ing the record the necessity for furnishing it. The original repair cards move on to the assorting desk where they are assorted into ownership and arranged in bill form. From the assorting desk they move to the machine operators who list them in duplicate on the bill form and complete the bill. The completed bill passes to the audit clerk for audit and is immediately mailed on completion, while the duplicate bill is held and listed on the shop report at the end of the month, from which the record is placed in the ledger for collection. The first figures of the audit number represent the month's account (1006, January account; 12006, December account). Duplicate bills are filed in binders, the backs of which are labeled "Audit Number from..........to.......... inclusive," which not only keeps the file in first class shape, but also insures ready location of any bill.

Duplicate copies of repair cards, together with any additional information that it was necessary to secure from the repair point before the bills were rendered, is attached to the original record and filed in 1,000-pocket cases according to the last three figures of the car number.

Foreign road bills are checked and vouchered in a central billing bureau. Exceptions to charges are written on the back of the billing repair card and turned over to a stenographer who writes a letter to the party rendering the bill. The checking is performed by the same clerks who render the system bill. This practice is desirable on account of the education it furnishes in allowing clerks to see what other road charge, and it tends to make uniform practice and charges in rendering and accepting bills.

All correspondence including answers to exceptions, is handled by the supervision of the office and any irregularities in pricing are called to the attention of the clerks responsible.

This system places in the billing office a complete file of all repairs made to cars, the value of which is apparent to all bill clerks in handling exceptions to bills as well as in tracing for wrong repairs, etc. It reduces to the minimum correspondence with the division people and delays in answering exceptions. It removes all inclination on the part of the division people to destroy bills, as their responsibility ends with the mailing of the records to the billing office, at the same time furnishing a complete safeguard against wilful destruction in the billing office. It abolished the entire billing force at division points and relieved the car foreman of all accounting work. It caused a payroll reduction of 50 per cent in handling bills and produced a higher degree of efficiency on account of closer supervision and the opportunity to educate the billing forces. The general results of the consolidated system have been satisfactory beyond our expectation.

With our system of billing, the traveling men are the connecting link between the billing bureau and the division people and they play a major part in the success of the system.

As long as we have the human element to contend with it is of decided importance that we keep a continual check on the shop tracks, transportation yards and interchange to insure that the intent of the A.R.A. Rules is being carried out in full. This can only be accomplished by surprise checks, in fact, that is the only kind of check that will furnish the actual conditions that exist.

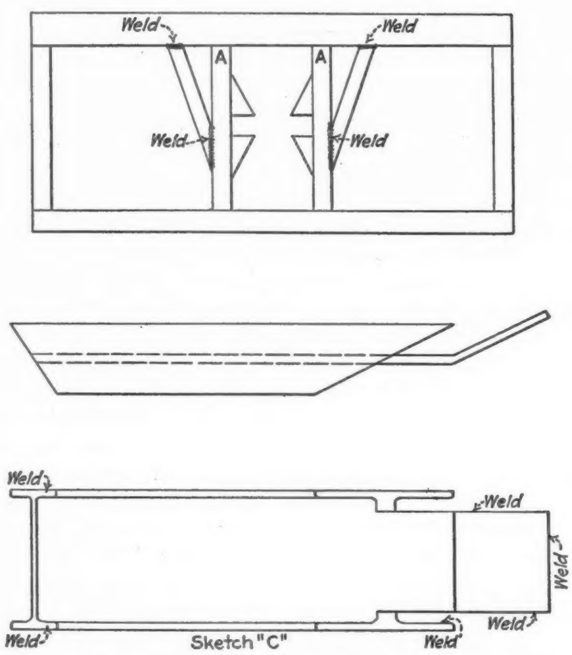
We do not require our traveling men to do any regular office work, except such work as is required to establish conditions on the outside, as we feel it is far more important to correct conditions than it is to correct past records. Our traveling men spend their time in educating employees and correcting conditions that are irregular. So far as possible the irregular conditions are corrected at the time located. If any conditions arise and continue to arise after having been called to the attention of the individual responsible, then reports are made to the higher officers for correction.

Welding used to strengthen center sill ends*

By Fred A. Cosgro

ONE of the illustrations shows at *A-A* the points where center sills frequently fail. It will be noticed that the failure occurs at the sill ends between the body bolster and the end sill which form the draft gear pocket. The pulling and buffing of the coupler sets up stresses which eventually lead to the fracture in the center sills. To overcome this trouble the center sill ends are stiffened by welding to each sill and the body bolster a section of 12-in. I-beam.

Two I-beam sections cut to the proper length, are



Sketches showing the method of laying out the I-beam sections and how they are welded in place

shaped at the ends, as shown in the sketch *C*, to fit in place against the body bolster and the web of the center sill channel. Two templates are used for laying off these sections. One template, which is laid on the top web of the beam, is used to lay off on one end of the sections the proper angle to fit against the body bolsters and, the other end, the correct angle to fit against the web of the center sill. The other template is used to lay off on the vertical web of the stiffener, the tongue which is welded onto the side of the center sill. This tongue is cut and offset to fit snugly against the center sill web. The two stiffeners are held in place and are arc-welded at the points indicated in the sketch.

* One of the papers submitted for the 1927 arc welding prize offered by the Lincoln Electric Company, Cleveland, Ohio.

The addition of these two stiffeners has eliminated failures in the sections of the center sills that form the draft gear pocket. The average cost for applying the stiffener to both ends of the car is $150, as compared with $300 for splicing the sills by the use of rivets.

Method of protecting gas cylinders

AT the large steel-car repair shops of the Pennsylvania, the cars are inspected on the outside and defective material removed before the cars enter the shop. Much of the work of removing material is done with the acetylene cutting torch. The cylinders

Method of protecting gas cylinders from being damaged by falling material

on the dismantling tracks, when sitting on the ground, are exposed to falling material. In order to protect the regulating valves and gages, the cylinders are placed under a metal frame set in the ground. This frame is made of two angle irons on the top of which is attached a wide metal hood which protects the regulating valves. A chain, attached to the uprights, holds the cylinder in a vertical position.

"Safety first" blue flag locked to the rail

THE blue flag, shown in the illustration, is constructed with the object of providing a flag that may be readily seen by all concerned and can not be moved except by some one who has the authority to do so. The mast consists essentially of two pieces of 2-in. by 3/8-in. iron bar which are forged somewhat along the lines of a pair of blacksmith tongs. The jaws of the tongs are shaped so as to fit the head of the rail and are pivoted at the bend of the tongs. One handle of the tongs holds the blue flag while the other is shaped to form a convenient grip for the hand. Provision has been made to secure a padlock to the flag by means of a chain. After the blue flag has been placed in position on the rail, the padlock is inserted through holes drilled

This blue flag cannot be removed without removing the padlock

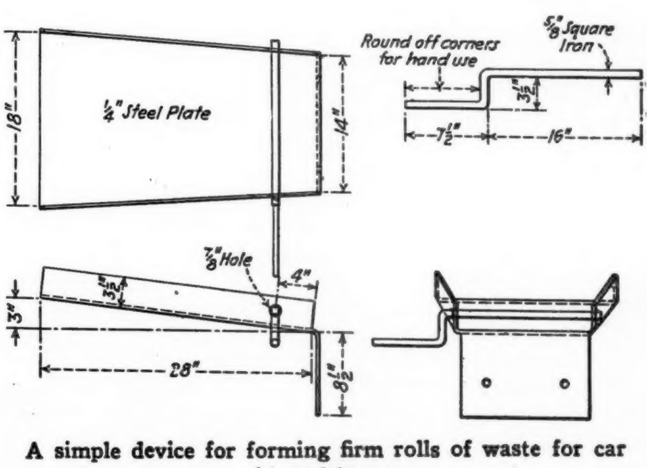
opposite each other in the two arms and by closing it the blue flag is locked to the rail.

A handy waste plug former

By L. Drieth

Car foreman, D. & R. G. W., Salt Lake City, Utah

ALL of the waste removed from car journals is reclaimed and put back in service. After the waste has been reclaimed, part of it is formed into rolls to be used as heels in oil boxes. These rolls are formed on the device shown in the illustration. It is made of ¼-in. steel plate, 28 in. long and 18 in.



A simple device for forming firm rolls of waste for car journal boxes

wide at one end, tapering to 14 in. at the opposite end. A handle, made of 5/8-in. square iron, is passed through a hole 7/8 in. in diameter. The waste is tightly wound around this handle, after which it is removed from the roll. This process gives a firm roll that does not require a string to hold it in place.

Valve and valve motion repairs

A description of the methods used in the back shop of a western railroad

By "Old Timer"

SOME of the construction methods employed by the locomotive builder, or by large railway shops, may be adopted to advantage in the smaller railway shops and enginehouses. The methods of handling valve repairs on a large scale when the shop is turning out one locomotive or more a day, differ materially from enginehouse or small shop methods. In the back shop, all of the repairs to removable parts are done at the benches. The erecting floor only applies the parts to the locomotive and sets the valves.

Types of valves used

Two types of piston valves are in general use—the solid valve cast in one piece and the built-up type (see Fig. 1), which consists of an assembly of two spiders, two bull rings and a valve body. The solid type valve, cast in one piece, is used with a single-piece valve bushing extending from end to end of the valve chamber. This type of valve is fitted with the common L-section packing ring. The assembled type of valve usually is fitted with Z-section packing rings which are held in place by a lip on the valve bull ring, and cannot get out of the ring groove when entering the valve into the valve chamber counterbore. A dowel extending through the bottom of each bull ring holds the opening of the packing ring at the bottom. A "hook" key, fitting in the spider and bull ring at the top, prevents the bull ring from turning on the spider.

The assembled type valve with Z-section packing rings is used with the two-piece valve bushing. This type of valve easily enters the counterbore of the inner bushing. With superheat, the assembled valves and two-piece bushings are necessary because of the thick carbon deposit which forms in the central part of the valve chamber. In one-piece valve bushings, this makes the valves difficult to remove after extended service. Even where two-piece bushings are used, the carbon deposit is so thick after extended service that it is often necessary to take the valve apart, and remove it from the chamber, one piece at a time.

Carbon burning

Carbon deposits form thickly in the exhaust passages all the way from the valve to the nozzle on superheated engines, and after years of service, becomes sufficiently thick to interfere with the working of the locomotive. This deposit is similar to that which forms on the cylinders of gas engines, and it may be removed by burning it out with the oxyacetylene cutting torch. Once the combustion is started with the torch, it may be continued by using a jet of compressed air, and the fire will spread rapidly through the exhaust passage leaving a loose, fine ash.

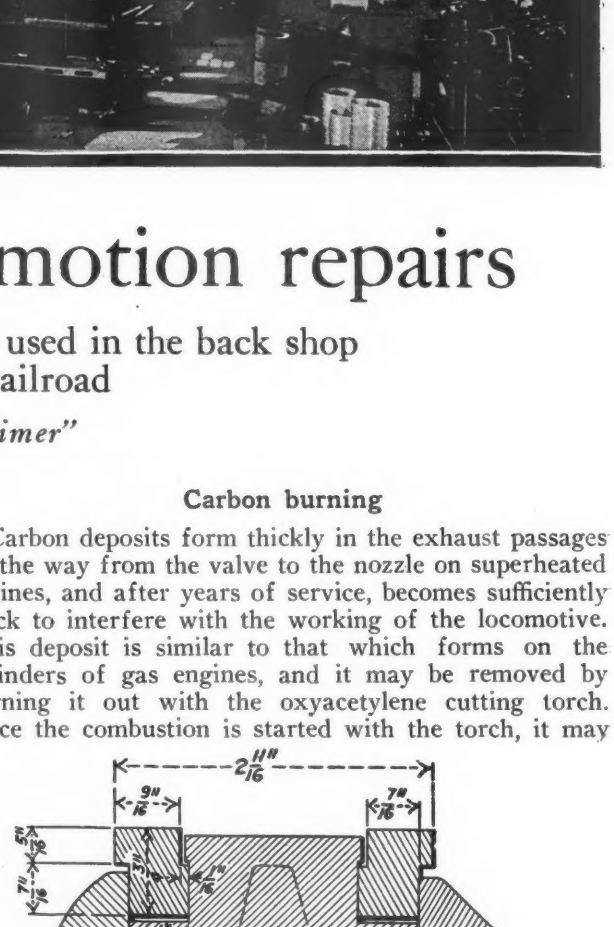


Fig. 1—Cross section of piston valve bull ring and Z-type packing rings

Motion work repairs

A complete set of blue prints of all parts should be available so that nothing is left to guess work. Also, the benches should be supplied with adequate tools, including a set of expansion reamers to ream bushings which close tight on the pins when they are pressed in place. The parts are completely stripped at the bench. Any worn or cut parts are noted, and these parts sent

to the welding shop to be built up by the electric welding process. The length of the rods may be incorrect. The radius rod length is frequently found to be wrong because this rod is often changed in the enginehouse to square the valves. When general repairs are made, radius rods, union links, eccentric rods, combination levers, and other motion parts should be put back standard and not assumed to be correct. In checking motion rods for length, lead strips are placed across

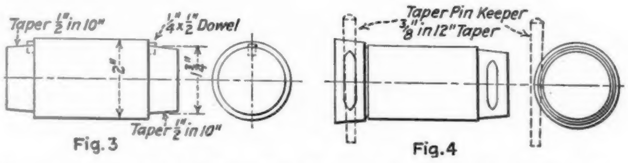


Fig. 3—One style of link-block pin for Walschaert gear; Fig. 4—Modern type link-block pin, secured by tapered pins

the pin holes, and the centers located on these. Adjustable tram points are used, set to blue print length, and any appreciable error is corrected in the blacksmith shop.

Motion pins

If the tapered fits of the motion pins are O. K., and there is sufficient stock on the body of the pin to true up somewhat larger than the largest part of the small end of the fit, the old pins are reused. New pins are case hardened after being drilled for cotter-pin and dowel holes. The threaded portion of the pins should be protected by screwing on a nut before the pins are placed in the hardening pot. The cyanide process, by means of which a pin is "potashed" in a few minutes, is not good practice for backshop work. A hardening process by which the pins are heated in contact with a carburizing agent for at least eight hours, gives a hard surface, extending 1/16 in. to 5/32 in. under the surface. There are various hardening compounds used to pack the hardening pot, but the following is good: Equal parts of wood charcoal, burnt leather and charred bone. Another hardening material is a mixture of barium carbonate and wood charcoal.

After hardening, the body of the pins is ground on a small cylindrical grinder, and then the bushings are fitted. Shops not equipped with this type of grinder polish the pins in a lathe with emery cloth after hardening.

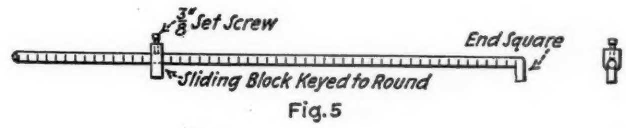
The common method of securing any pin is by a nut. There are many cases where a nut cannot be used on a valve-motion pin; for example, the link block pin of an engine having a Walschaert valve gear. The middle pin on the combination lever of a locomotive with the extension type of back valve head has no clearance where a nut might be used. Baldwin Locomotive Works practice is to make the ends of these pins flush and secure them by one or two tapered pins driven in a small reamed hole passing through the edge of the pin, as shown in Fig. 4. If located at the edge of the pin, the peg will not be as apt to shear off as if passed through the center of the pin, for a much longer bearing in the joint is provided.

There is a style of construction which secures the link block pin in the radius rod, as shown in Fig. 3. The body of the pin is larger than the two fits which taper opposite, and the two halves of the radius rod are drawn tight on the pin. This style of link block pin cannot be removed without taking the radius rod apart. Two dowels prevent the pin from turning. Joints in the motion work should fit 1/32-in. loose. Excessive lateral motion is taken up by building up the worn part by gas or electric welding if it is badly cut. If it is not worn too much, the lateral on a jaw may be taken up by closing it in a press. Joints should be tried by assembling the parts at the bench, and tightening the nuts on the pins to make sure that the joint does not bind.

As soon as the valves are removed, the bushings are calipered, and if out of round over 1/32 in., or over 1/32 in. tapered, the valve chambers are bored. The back heads are removed so that the chambers can be bored easily, and the back valve rings properly fitted. If two-piece bushings are used, the distance between the admission ports to the back and front ends of the cylinder is checked with a valve-spacing gage consisting of an adjustable block sliding on a hooked rod, as shown Fig. 5. Bushings not properly spaced cause an error in the lap of the valve unless a special length of valve is used to overcome the error.

Variety of methods found in different shops

There is considerable variation in practice in handling valve repairs in different shops. One road bores the valves ⅛ in. over standard at the first boring, and ¼ in. over size at the second boring. In this manner, a stock of finished bull rings may be kept on hand. Common practice, however, is to bore out the chamber just enough to clean it and get under the hard skin which forms on cast iron. The limit of wear on a valve bushing is commonly set at ⅛-in. or ¼-in.; that is, when enlarged this amount over standard, the bushing is cut out and a new one applied. Valve bushings



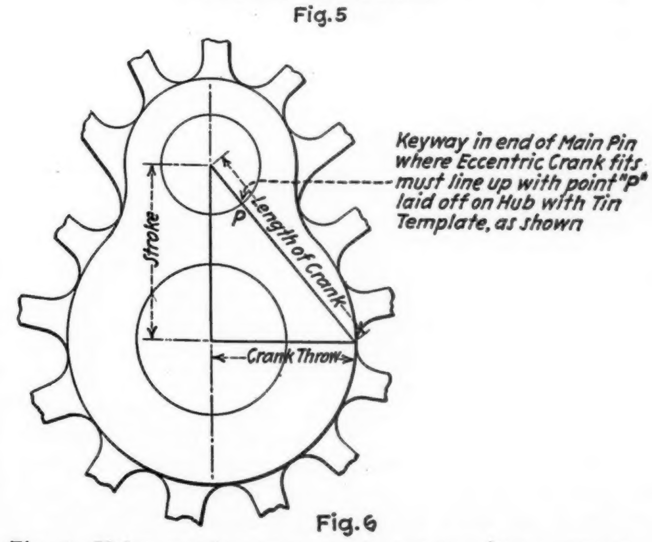


Fig. 5—Valve spacing gage, graduated in eighths; Fig 6.—Template for lining up the keyway center lines

are cut out by chipping a groove through the bottom of the bushing with an air hammer and round nose chisel, and then driving it out after the keepers have been removed. The practice of heating cylinders to apply new valve and cylinder bushings has always been questionable. Many cylinders have been cracked. A puller, which draws the bushings in place, using the compounded power of an air motor to screw a nut on a threaded bar, is the method used by locomotive builders. If properly geared down, an air motor will develop

power enough to strip a 2½-in. standard nut. The inside of the valve chamber where the bushings fit, should be bored out, if out of round, or it will be difficult to get a good fit on the bushing. The allowance for the press fit on a valve-chamber bushing when the bushing is to be drawn in place by screw action is .010 in.

Two sizes of rings carried in stock

For every standard size of valve there are two sizes of valve rings carried in stock; namely, standard size and oversize. For valves up to 14 in., the standard-

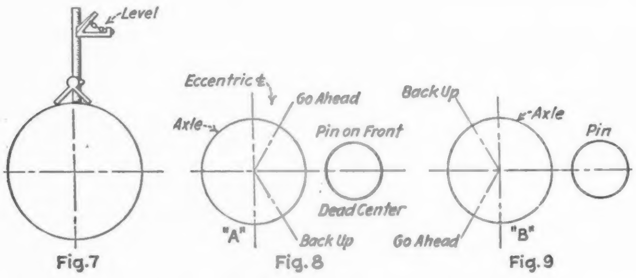


Fig. 7—Method of using combination square, with the center head attached, to obtain the location of the quarter line on the axle after the wheels are mounted—One pin is plumbed using a plumb line over the crank pin and the square is applied as shown; Figs. 8 and 9—Eccentric center line location with reference to crank pins; Fig. 8—Outside admission; Fig. 9—Inside admission

size ring is ⅛ in. larger than the chamber, and the oversize ring is ¼ in. larger than the standard valve chamber. Oversize rings are used when, by repeated borings, the chamber size approaches the size of a standard ring. Oversize rings for valves over 14 in. in diameter are made ⅜ in. larger than the standard valve size.

Many men break a valve ring at one point by striking it sharply against some corner such as the edge of a vise; then place the ring in the chamber, lapping the ends and marking with a scriber the exact amount to be cut out, and then saw the ring to suit. A ring broken in this manner is usually knocked 1/64-in. or more out of round, as a little experimenting in fitting a ring in a round chamber will show. The ring should be sawed in two, instead of broken, to get a good fit. When a ring is cut, the ends have a tendency to spring out in such a way that, when the ring is placed in the valve chamber, the entire circumference does not bear against the wall. To overcome this distortion, the ends of the ring should be lightly filed for several inches back where they bear heaviest against the chamber wall. Sometimes it is necessary to bend or spring the ends of the rings inward to receive a satisfactory bearing. It is also possible to bend a valve chamber ring to fit a chamber worn out of round. Spotting valve rings by use of lamp black, Prussian blue, chalk, etc., is too tedious and slow for railroad shop work. The use of a feeler gage, .020 or .030 thick is quicker, and if this feeler will not go in between the packing ring and chamber wall at any point on the circumference of the ring, the fit of the ring may be considered O. K. The problem of spotting a ring in a cylinder is a common one in the mechanical field.

In fitting the rings to locomotive air compressors, a method has been devised by which the rings are ground round after they are cut, thus eliminating the tedious spotting process. In fitting valve rings in the enginehouse, it is not customary to devote much time to spotting the rings. Rings poorly fitted will blow the first trip, but eventually wear to a bearing against the valve-chamber wall. The amount of opening to leave between the ends of a valve ring is generally set at 1/32-in.

Locating the keyway on the wheel

It is desirable to cut the keyway in the main pin before the pin is mounted in the wheel, and then turn the pin so that the keyway will be in the proper position. When the pin is turned in the lathe, a straight mark is placed the length of the eccentric crank fit, and this mark is extended along the wheel fit. This line is made the center line of the keyway. A line is placed on the wheel hub which is lined up with the keyway center lines previously scribed on the crank pin. To scribe the line on the wheel hub, which represents the position of the center line of the eccentric crank in reference to a line drawn from the axle center to the pin center, a tin template is used such as shown in Fig. 6. This is a triangle, the hypotenuse of which is equal to the length of the eccentric crank (distance between centers). The base of the triangle is equal to the radius of the crank pin circle, and the altitude is equal to the radius of the eccentric-crank circle. The exact location is determined by the valve setter, and an offset key is used if necessary.

The key is then placed after the eccentric crank bolt is fitted, and merely assists the bolt in holding the crank rigidly on the pin. Methods used by valve setters to set eccentric cranks might be better considered in a discussion of valve setting, but it may be said in this connection that there are two general methods. The first is to locate the crank in such a position that the link heel is in exactly the same position when the engine is on either of the dead centers. This method, which requires several hours, requires catching the dead centers, and also the use of pinch bars or rollers. The other method is to set the crank to give the correct specified throw, and is done by taking the actual throw of the crank, using a long tram in the eccentric-crank pin center, and scribing the actual throw on the side of the cylinder, or on a board clamped near the guides for this special purpose. If the crank does not throw correctly it is knocked to or from the axle center, and the locomotive trailed again until the proper throw is secured.

There is also a device for setting cranks to the specified throw without trailing the locomotive. To do this, it is necessary to measure a distance equal to one-half the eccentric crank throw, measured from the axle center line extended out to the plane of the eccentric-crank pin center. A device for doing this has a ball center which fits into the wheel center, and a collar sliding on the rod which, when pressed against the axle, squares the rod. An adjustable radial arm set to one-half the crank throw is used to locate the eccentric-crank pin center. In the absence of this device the eccentric-crank throw or travel circle may be scribed on the wheel hub with dividers and, by the use of a combination square, moved along this line. The center on the back of the eccentric-crank pin may be set to this line.

Reverse shaft repairs

It is not always necessary to remove the reverse shaft from the locomotive even in case of general repairs. The bearings may be closed and the small

radius-rod hanger bushings renewed at the engine. Turning reverse shaft bearings in the lathe is a rather troublesome job on account of the long arms on the shaft. These arms may be bent out of the way by heating with the welding torch. If there is a lathe large enough to swing a tumbling shaft without bending the arms, the bearings may be turned, using an extension tool holder, which is a heavy bar about four feet long, arranged to hold an Armstrong tool in one end. In building new reverse shafts, they are often forged without the arms. These arms are forged separately and welded in place by the gas or electric process. In enginehouse work, a cracked reverse shaft should receive prompt attention since, once a crack starts in this part, the locomotive will seldom make one trip without breaking the shaft.

Eccentric crank repairs

Eccentric cranks frequently work loose on the pin, and at the time of general repairs they should be closed if necessary. The best method is to caliper the pin, and if the crank is loose, it is taken to a hand press, and the split portion pressed together until a fit is secured. Another method commonly used in enginehouse work is to heat the crank to a red heat, place it on the pin hot, and draw it together with the draw bolt. The crank closes, and will be found to be a tight fit on cooling. Trouble is often caused by the eccentric crank pin being out of square. This defect makes it impossible to line up properly the eccentric rod jaw which fits over the link heel. With the locomotive spotted in a certain position, the jaw may line up correctly and fit freely over the link, but if the main wheels are turned half a turn, the eccentric-rod jaw may be several inches out of line. As may be readily seen, if the eccentric crank pin is out of parallel with the main pin, this error will be greatly magnified at the end of a long eccentric rod, especially if the bushing in the back end of the eccentric rod is a snug fit. To test the eccentric crank pin to see if it is square, the crank is placed on a mandrel which is bolted down squarely to a face plate. A square is then used on the face plate, and any error will be shown by variations seen in calipering from the pin to the square. If the error seems to be due to a bent crank (bent in the web portion), it may be straightened in the press. If it is out as though the crank were twisted, it will probably be necessary to press out the eccentric crank pin, and rebore the pin hole. The pin is riveted over on the back like a crank pin. The eccentric crank pin is not case hardened.

Increasing travel and lap

Some locomotives have been completely rebuilt for greater capacity, changing the stroke, frames and valve travel. It is often possible to change the lap and increase the valve travel and still use the original cylinders and valve bushings. An increase in lap requires a shorter valve body on an inside-admission engine and, to keep the exhaust clearance approximately the same, a longer valve bull ring may be used. The exhaust clearance varies from line-and-line to 1/16 in. on the older locomotives, but it may often be increased to 1/8 in. with beneficial results at the time the lap and travel are increased. By carefully following the designer's blue prints at the time of conversion, it is possible to build a locomotive that requires only a few slight changes at the time of valve setting, to square the valves. These changes are confined to the valve stem and eccentric rod and may be figured by simply trailing the engine over as in enginehouse valve setting.

Locating eccentric keyways

In spite of the fact that the Stephenson link motion was considered obsolete fifteen years ago, there are still many locomotives which are equipped with it, and it is desirable to know a good method of locating these keyways in the axle approximately before the valves are set. In all of the larger shops it is customary to cut the keyways and mount the eccentrics and straps before the wheels go under the locomotive. They are cut, preferably by milling them out, sometimes on the drill press, and sometimes by drilling with a motor and chipping. At the time of valve setting, any errors are corrected by applying offset keys. In this connection it is not necessary to go into the details of valve setting, any errors are corrected by applying offset keys.

The first step in locating keyways is quartering the axle. A new axle has quarter lines drawn on it at the time of turning and these may be used. Even on an old axle, the quarter lines may sometimes be found after scraping off the paint. To quarter the wheels in the absence of previous marks, one crank pin should be plumbed. This is done by hanging a double plumb bob over the pin and drawing a circle, struck from the axle center, the same diameter as the crank pin. The wheels are rolled until the strings of the plumb bob are tangent to the scribed circle. Now, by the use of the combination square, see Fig. 7, with the center head attached, it is possible to draw one quarter line on the axle. The level in the square head shows when the scale is exactly vertical and the center square holds it on the axle radius. A mark is made at the end of the scale and the operation repeated near the other wheel and the quarter line then drawn. The other crank pin may be plumbed to locate the corresponding quarter line and the other two quarter lines established by measuring around the axle with a steel tape.

It is generally known that on a locomotive having no lap or lead, the eccentrics should be set 90 deg. from the pin, exactly opposite each other on the axle. All

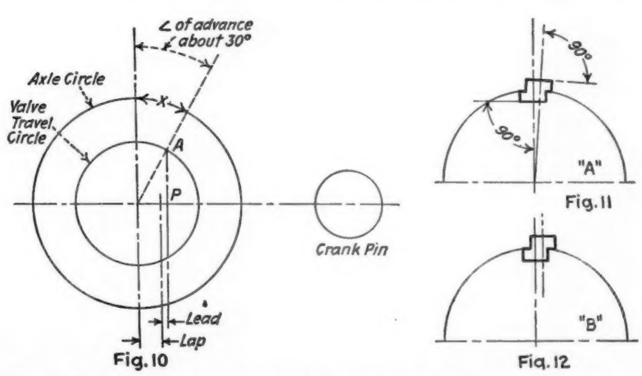


Fig. 10—Method of determining the distance to move the eccentric from the quarter line; Fig. 11—Offset key laid out radially; Fig. 12—Offset key laid out square, which is the customary practice

locomotives have lap, and nearly all of them lead, so the eccentrics are set away from the quarter line enough to displace the valve from its center position an amount equal to the lap plus the lead. There is apt to be some confusion in deciding which quarter line to measure from in locating the eccentrics. There are two locations used for different arrangements of admission and motion which the valve setter should have fixed in his mind and locate the eccentrics accordingly. Assuming a locomotive on the front dead center as the wheel

starts to move forward, the forward motion eccentric must move the valve in the direction to open the steam port to the front end of the cylinder. On an indirect locomotive with outside admission, it should follow the pin, see Fig. 8, and on an indirect locomotive with inside admission, it should lead the pin, as shown in Fig. 9.

To determine how much to move the eccentric from the quarter line, it is necessary to make a small diagram on a piece of sheet metal, or, perhaps, on the end of the axle. Two concentric circles are drawn, one with a radius equal to the valve travel and the other with the same radius as the axle where the eccentrics fit. A diameter is drawn and a perpendicular radius erected. The point where the diameter cuts the axle circle at the right is assumed to represent the dead center position of the crank pin on a reduced scale. Now, a distance equal to the lap plus the lead is laid out from the center of the circle on the horizontal diameter. This establishes point P on Fig. 10 on the diameter from which a perpendicular is erected, cutting the valve travel circle at A. A radius is now drawn passing through A, and extended until it cuts the axle circle. The distance X is the distance the eccentric center line should be moved from the quarter line. One thing to watch, in laying off eccentric keyways before the wheels are mounted on the axle, is the location of the keyway in the wheel. This keyway may be on the side of the axle hole toward the crank pin, or it may be directly opposite. This would make a difference of 180 deg. in the location of the crank pin, and necessarily the same difference in eccentric location, so the valve setter should have in mind the location of the pins regardless of the location of the axle keyways. Some valve setters try to correct the keyway location for a locomotive that is high, or has the crosshead-pin centers several inches above the axle centers. It has been found that this practice does not pay and it is better to locate the eccentrics from the crank pins than from the center line of motion.

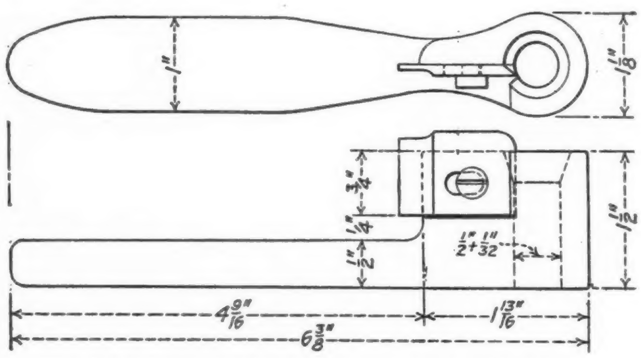
Offset keys

An offset key, as will be seen from Figs. 11 and 12, if it fits properly, is rather difficult to make, as the top surface and bottom surface are not parallel to each other, but are at right angles to different radii. The sides of the offset portion are parallel to different radii, as shown. In railroad work it is not customary to plane the key radially, but as shown in Fig. 11. The offset portion that does not fit properly in the keyway after the eccentric is mounted, is planed square. Good practice is to fit up the eccentrics with straight keys before valve setting, then if it is found that some must be changed, the key may be built up on one side by welding and refitted much quicker than making a new key. If eccentric keyways are laid off with reasonable care, about ¼ in. is the greatest offset that will ever be required to square up the lead.

Tool for turning wood dowel pins

By A. M. Hollis
Pattern shop foreman, Fort Worth & Denver City, Childress, Texas

THE dowel pin turner, shown in the sketch can be made for turning dowel pins, chair rounds, etc., in various sizes from ¼-in. up. The body and handle of the tool is made of brass, which is provided with an adjustable steel blade. The blade is ground to cut the desired contour or shape. The hole, into which the dowel pin is inserted as it is turned down, is drilled 1/32 in. larger than the diameter of the pin.

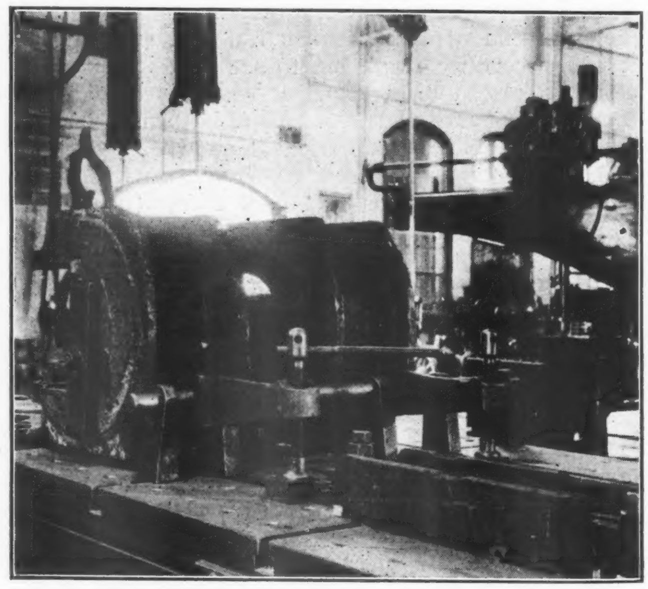


Sketch of tool for turning ½-in. dowel pins

The body of the tool used for turning ½-in. dowel pins is 6 ⅜ in. long. The length of the handle, however, should be increased to provide a firmer grip when turning pins of larger diameter.

Securing driving boxes to the bed of a planer

SHOWN in the illustration is a device for clamping driving boxes to the bed of a planer, which is used in the machine shop of a southern railroad. It consists essentially of a lever arm, the fulcrum supports of



Two boxes clamped in position for planing

which fit into the cross-grooves of the table. One end of the lever arm rests in a recess in the driving box and the opposite end is provided with a screw, as shown in the illustration. This clamping device can be constructed to hold as many driving boxes as the planer has toolheads. In this case, two boxes are shown clamped to the planer table to be machined simultaneously.

Time saving devices in Maine Central air brake shop

Kinks developed to expedite and improve quality of output—Feedwater-heater test rack has proved its value

THE principal repair shops of the Maine Central are located at Waterville, Me. At this point, practically all of the locomotives receive class repairs. The erecting shop, machine shop and air-brake shop are all under one roof. The air-brake department, which employs 23 men, including the foreman, occupies two floors. Steam, air and signal hose are repaired on the second floor, while the remainder of the work is handled on the first floor. The shop is well provided with modern tools and shop equipment. Of particular interest are the many cleverly designed shop-made devices that have aided materially in increasing production, reducing the cost of repairs and improving the quality of workmanship. Most of these devices were designed and built under the direct supervision of J. M. Bartlett, foreman of the air-brake shop.

Angle-cock grinding machine

Of particular interest is an eight-position valve grinder, which will grind an average of 100 angle cocks in eight hours. This machine, which is illustrated in Figs. 1 and 2, is driven through a series of gears by an electric motor. The reciprocating motion is imparted to the sliding crosshead bar through the crank, connecting rod and the crosshead. To the crosshead bar is attached a crank which is centrally located with respect to the connecting rod and carries the crank arm which is free to turn around the spindle when the clutch is disengaged. The clutch is fitted on the square end of the spindle. Therefore, when the clutch is engaged with the crank arm, the spindle turns back and forth with the crank arm.

The spindle socket is fitted on the top square end of the spindle and thus must turn with it. The spring under the socket allows the socket to adjust itself to the different lengths of necks on the angle-cock plugs.

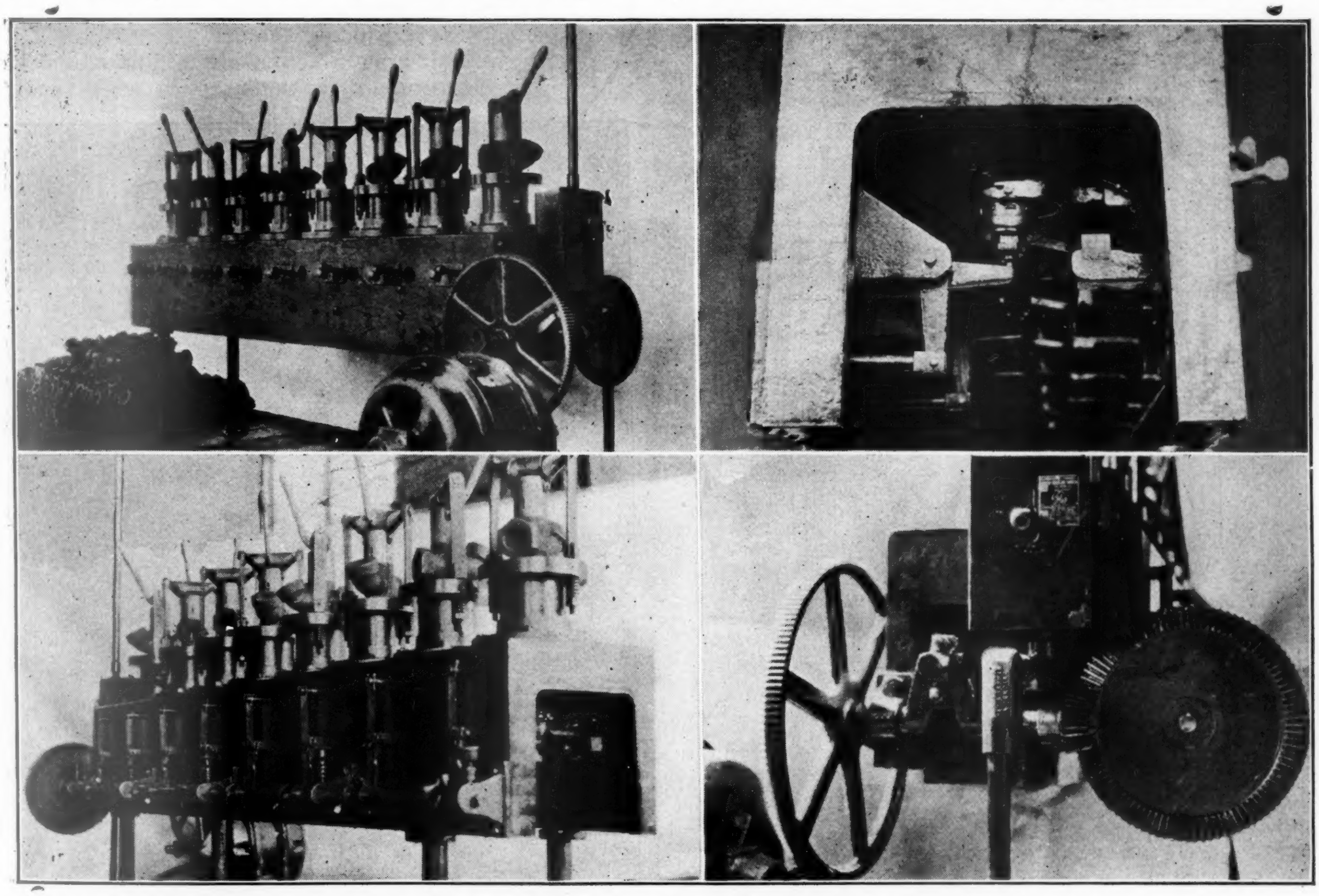


Fig. 1—Left top and bottom—Front and rear views of an eight spindle angle cock grinding machine; Right top—Looking under the table of the machine; Right bottom—The driving gears

The spindle is ball-shaped at its bearing in the bottom of the spindle barrel and has a clearance throughout the barrel length for the sake of flexibility to make up for the square end of the angle-cock plugs not always being central.

When placing an angle cock in the machine, it is centered and clamped in place by centering pins, located in the top surface of the spindle barrel, and the eccentric

clamp lever and friction head. The square end of the angle cock plug sets in the spindle socket and turns with it.

The ratio of the bevel gears, shown in Fig. 1, is four to one, and the cam shaft turns at one-quarter of the speed of the crankshaft. The cams operate once in every eight strokes of the crank. When the cam depresses the lower end of the dog lever, the dog, which has a tongue milled on the inner end, is withdrawn from

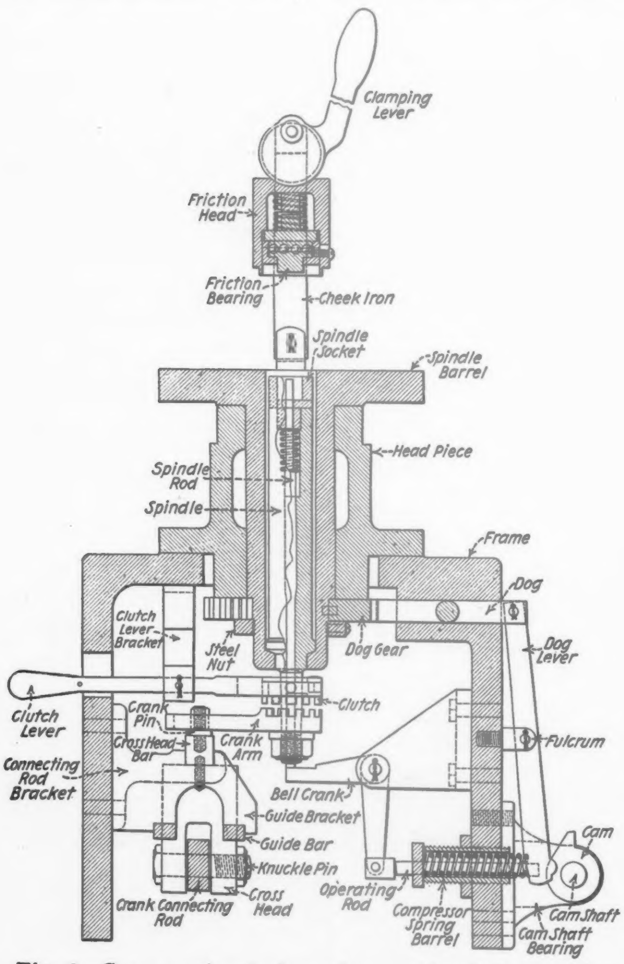


Fig. 2—Cross-sectional view of one unit of the machine shown in Fig 1

the dog gear. As the tension of the spring in the friction head causes a certain amount of friction between the angle-cock body and its plug, the bottom raceway of the friction head bears directly on the plug, and the outside shoulder of the friction head bears on the angle cock body. Thus, when the dog is withdrawn from the dog gear, the spindle barrel, with the angle-cock body, moves the distance which one stroke of the crank will turn it, or about one-fifth of a turn. Then, as the cam passes down by the end of the dog lever, the spring back of the dog lever forces it out, causing the dog to latch in the dog gear. Immediately, the spindle rod cam engages the outer end of the operating rod which, in turn, operates a bell crank causing the spindle rod to rise and lift the angle-cock plug from the bearing against the walls of the angle-cock body. This is done to prevent grooving of the bearing during the grinding operation. This description covers one cycle of the operation of one unit. A 2-hp. motor is used to drive an eight-unit machine.

Painting triple valves

Between 5,000 and 6,000 triple valves are repaired each year at this shop. To hand-paint these valves requires considerable time and does not give a smooth, even paint surface. To expedite the painting of these valves, they are dipped in a vat, shown in Fig. 3. This is an all welded square vat which holds ten gallons of paint consisting of lamp black, shellac and a little varnish. This mixture gives a hard, glossy paint surface. The paint is occasionally thinned out with alcohol. Before dipping the valves, the exhaust ports and train-line connections are plugged. After the valves have been dipped, they are hung on six hooks and the excess paint is allowed to drip off and drain down the apron into the vat. It requires about five minutes for the valves to dry.

Handling air-compressor repairs

The air-compressor cylinder bushings are ground on a Micro internal grinding machine. In order to line up the compressors accurately on the machine table, a wood centering strip is placed in each end of the compressor cylinder. This work is done on a stand which can be turned in any position. As shown in Fig. 4, the pedestal consists of a tubular column on the top of which is mounted a flat piece of boiler steel which revolves on the top end of the pedestal. On this pedestal the machine operator can be preparing one compressor for grinding while the machine is grinding another.

Almost every air-brake shop has devised an adjustable table on which to mount the compressors while repairs

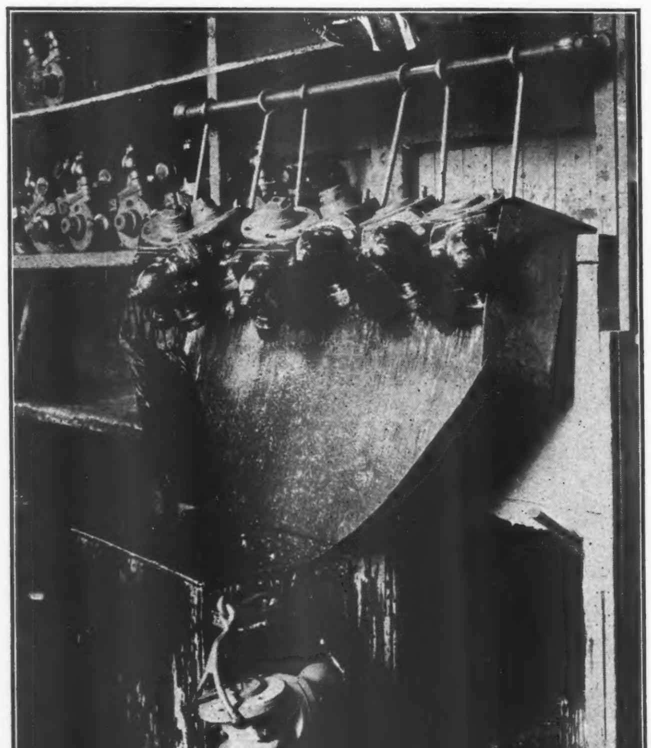


Fig. 3—Six triple valves drying after being dipped in the paint vat

are being made. The tables shown in Fig. 4 are simple in construction, yet very effective. Each consist of a heavy cast-iron base, on one end of which is attached a fixture by means of which the compressor can be fixed in any position through an arc of 90 deg. The bed of the table contains two shelves on which can be placed parts of the compressor or tools.

The Maine Central reclaims worn and under-sized air-compressor piston heads by building them up with bronze, using the welding process. After the welding is completed, the heads must be machined to standard size and two new piston ring grooves cut in them. A chuck for holding and centering the piston heads on the table of a vertical boring mill has been designed for the purpose of speeding up the operation and to secure accuracy. The chuck, which is shown in Fig. 4, has a boss on the bottom side which fits snugly into the center hole of the boring-mill table. This boss centers the chuck on the table, after which it is securely clamped by four vee-straps. The central hole of the chuck is somewhat larger than the diameter of the piston rod of the largest size. The chuck is split three-quarters of the way across on the center line of the hole. Steel bushings are made to fit the center hole in the chuck and the diameter of the different sizes of piston rods. The piston with the proper size bushing is placed in the chuck, after which the binder bolt is tightened, thus holding the piston head in a central position, eliminating the necessity for truing up the head before starting the finishing cut. After the head is machined to standard size, two tools are placed in the tool post for the purpose of cutting the ring grooves in one operation.

Repairing air hose

All hose repair work is handled by one workman, which is made possible by the use of several shop-made machines designed to expedite repairs. The fittings are removed from the hose on the machine shown at the left in Fig. 5. This machine consists of three units, each controlled by a foot pedal. The unit at the right is used for cutting off the bolts which are placed between shear jaws operated by a foot pedal that controls the admission and exhaust of the air from a 5-in. air cylinder. The cylinder piston is forced down on the hose, thus causing the shears to cut off the bolts. The hose fitting is then placed in the middle unit which, when the piston is forced down on the hose, causes the fixture to spread the hose band. The cutter for stripping the hose from the nipple

Fig. 4—Left—Chuck for centering and holding air compressor piston heads on a vertical boring machine; Center—Metal adjustable work benches on which air compressors are assembled; Right—A revolving pedestal on which air compressors are prepared for the internal grinding machine

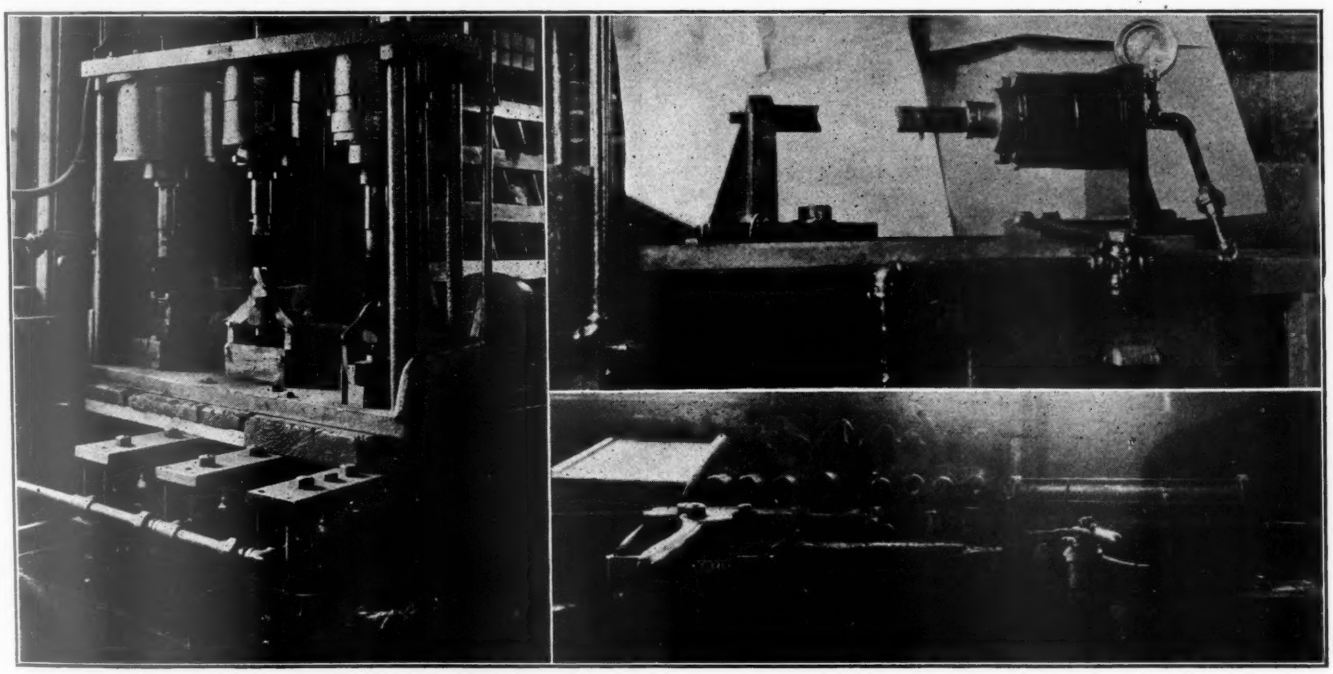


Fig. 5—Left—Three station hose dismanteling machine; Right top—Hose band clamping machine; Right bottom—Machine for forcing nipples into new hose

is made of two jaws so spaced as to admit the hose fitting. When the foot pedal is depressed, the air forces the piston in the 8-in. cylinder down on the hose, forcing it against the two cutters which cut the hose on both sides of the nipple. In three operations the fixtures are quickly removed from the hose.

200-lb. pressure. Referring to Fig. 6, the shop pressure first passes into an 8-in. air cylinder which is mounted tandem with a 14-in. cylinder. The upward movement of the 14-in. piston compresses the air already in the 8-in. cylinder, thus building up a pressure that ranges from 200 to 210 lb. A reducing valve is placed in the air

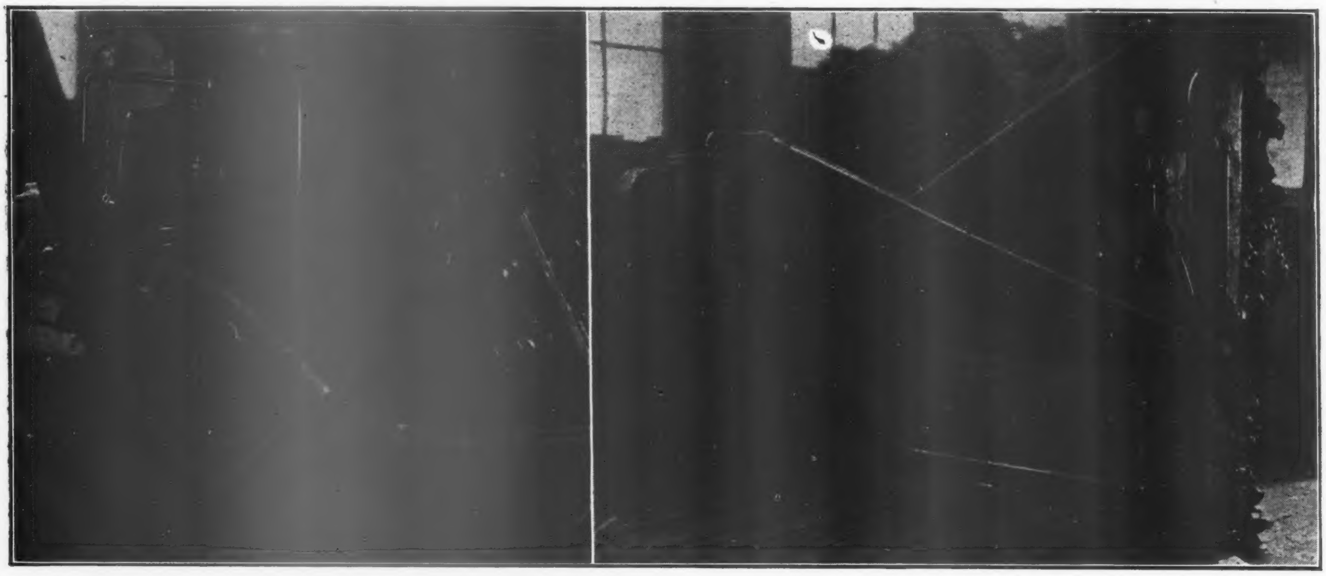


Fig. 6—Two views of the hose testing rack

line in the 14-in. cylinder which controls the air supply to this cylinder.

The hose to be tested is screwed into the fitting on the

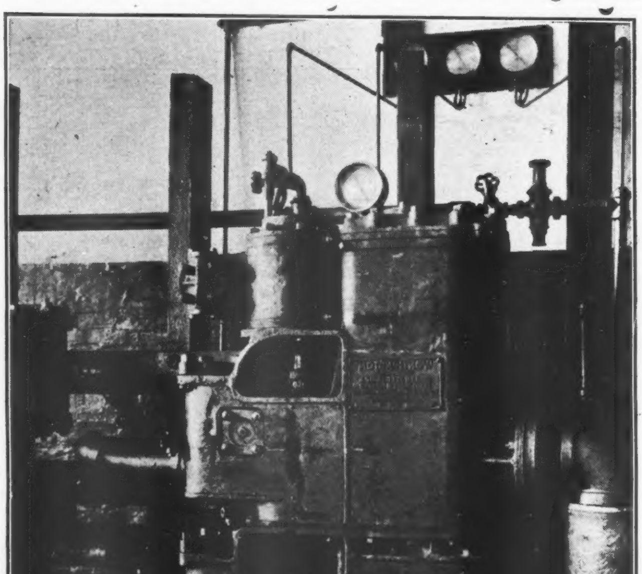


Fig. 7—A rack on which Worthington feedwater heaters are tested

test rack. Another hose is clamped to the end of the test hose. The open end of the second hose is capped. The pressure is applied and when the air gage shows 200 lb., the hose is carefully examined for leaks and

When the foot pedals on this machine are depressed, they operate a lever connected to a quick-acting valve, the admission and exhaust valves of which are operated by a fulcrum. Thus, when the pedal is depressed, the admission valve is opened and the exhaust valve is closed. Springs operate the valves in the opposite direction when the pedal is released. The shears and the band spreader are returned to the closed position by coil springs located under the stem of the fulcrum.

In Fig. 5 is shown a device which is designated as a blowing-in machine, used for forcing the fittings into new hose preparatory to placing the bands around the hose. The hose is placed in a wooden clamp operated by a handle which forces a cam along the side of the clamp, thus securely holding the hose in a horizontal position. A suitable fixture, that fits over the nipple to be forced into the hose, is placed on the end of the air cylinder piston. When the air is applied by a three-way valve, the piston forces the nipple home into the end of the hose. It requires two operations to force in the nipples in both ends of the hose.

The next operation is to apply the bands around the reclaimed fittings and new hose. This machine, which is shown in Fig. 5, is operated by a 5-in. air cylinder controlled by a three-way valve. Suitable fittings have been made to fit on the end of the piston and the adjustable tail stock of the machine. These fittings are made to conform with the different types of hose bands. When the air is applied, the two clamping tools force the band tight around the hose and draw it up tight so that the clamp bolt can be quickly applied.

A reducing valve is placed in the air line to control the air pressure, and a check valve is placed between the three-way valve and the air-cylinder to control the admission of air into the cylinder for the purpose of eliminating vibration.

The assembled hose are now ready for testing. They are subjected to an air pressure of 200 lb. As the shop air line pressure is only 100 lb., it is necessary to use the principal of compounding in order to secure the desired

defects. Upon completion of the test, air is exhausted from both cylinders and the air hose is removed.

A feedwater-heater test rack developed and built in this shop

Besides repairing air-brake equipment, much other miscellaneous work is handled in this shop. At the

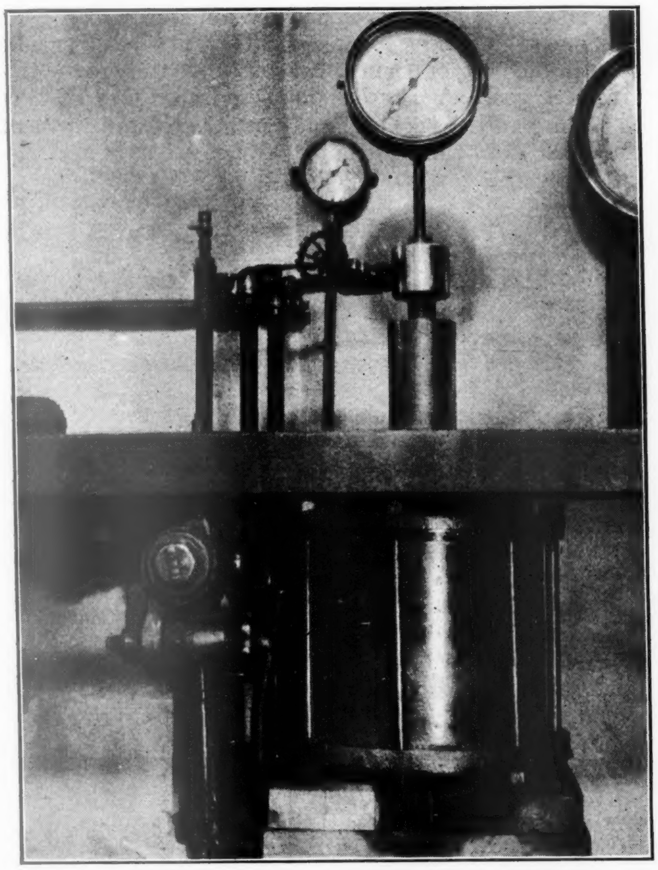


Fig. 8—A device for testing hydraulic gages that record pressures up to 600 ton

present time about 12 locomotives are equipped with Worthington feedwater heaters and more are to be so equipped. As the heaters are repaired at these shops, it was thought desirable to test the heaters thoroughly before they were placed on the locomotive. A test rack has been developed for this purpose, which has resulted in the elimination of much time and labor in fixing defects after the feedwater heater has been mounted on the locomotive.

The test rack, with a feedwater heater mounted in position, is shown in Fig. 7. The heater is held on the heavy metal frame by four 1⅛-in. bolts. A 1-in. steam line is tapped off of the steam main and led to the steam chest of the pump. A steam gage is placed in this line. The back pressure is built up by passing the pump steam exhaust and additional steam from the main steam line through a pipe to the back-pressure chamber. A valve is located close to this chamber so that the exhaust steam from the pump can be shut off from the back-pressure chamber and automatically by-passed, through a spring-loaded shutoff valve, to the sewer. The cold water-supply pipe leads directly from the shop water-supply line to the proper connection on the pump. At the left of Fig. 7 may be seen a reservoir on the top of which is a flange that connects with the exhaust-steam inlet flange on the heater. This reservoir is designed for the same volume as that of the pipe through which the exhaust steam passes from the locomotive cylinder to the feedwater heater.

After the heater has been securely bolted to the rack and all of the pipe connections have been made tight, the pump is started and allowed to run the prescribed number of strokes per minute for a short time in order to develop any leak or irregularities. Then the spring-loaded shut-off valve in the discharge line is closed until the gage in the line registers the desired boiler pressure. At this point, the gage connected in the water line from the cold-water cylinder to the valve on top of the heater head should register the correct pressure.

The next test is to admit steam to the back-pressure reservoir until the pressure gage registers 5 lb. This operation will slow down the pump piston speed and cause the escape of steam from the overflow. The piston speed is then increased until the escape of steam from the overflow stops. The pump is then again functioning properly and condensing steam, this constitutes the condensation test.

The slip test is next made to determine if the discharge and suction valves are tight and whether the water is slipping past the piston packing in the cylinder. To make this test, the steam to the back-pressure reservoir is

Fig. 9—Top; A device for testing small coil springs; Bottom—Ball seat water glass joint

shut off, the steam gage valve closed to obtain the desired pressure without damage to the gage and then the piston speed timed the prescribed number of strokes per minute. When the spring-loaded valve in the discharge line is closed, the piston speed should be according to the instructions given by the manufacturer.

If the water does not run from the overflow after the above test is made, remove the pipe plug from the top of the heater head and fill the bucket with water until the water runs, and then make the bucket test according to the instructions given by the manufacturer.

Hydraulic gage-testing device

All of the hydraulic gages used on the Maine Central system are sent to the Waterville shops for repairs. In order to calibrate these gages accurately, a testing device has been developed and built in this shop. Gages recording pressures up to 600 tons can be tested by the use of the shop air pressure. The principle of compounding pressures by two different sizes of cylinders is used to obtain the pressure of 600 tons. Referring to Fig. 8, the small 1-in. cylinder, shown above the table, is filled with oil by air pressure. Immediately beneath this cylinder is another cylinder, 10 in. in diameter, which gives a piston area of 78.54 sq. in. The shop air pressure is led into this cylinder, which forces up the large piston and builds up great pressure in the oil cylinder. The air pressure in the large cylinder is regulated by a pressure reducing valve and a B-6 feed valve. The oil overflow is carried from the oil cylinder to the oil reservoir located beneath the work bench. The test gage at the left shows the shop air pressure and the gage at the right is the one under test. A suitable scale of pressures for different sizes of hydraulic rams on which the gages are used, has been worked up. The correct pressure is determined by multiplying the test-gage reading by 78.54 sq. in., the piston area of the large cylinder, and the product by the area of the hydraulic machine ram, and then dividing by 2,000. This equals the tons pressure being exerted on the gage under test. These calculations are checked against the actual readings of the gage to determine their accuracy.

A device for testing coil springs

Many small coil springs are used in locomotive specialties. When these parts are repaired, it is essential to determine that the springs have not become weakened through usage. In order to determine this fact, the spring-testing machine, shown in Fig. 9, has been built to exert a maximum pressure of 400 lb. which is required when testing the holding-down spring used in a feed-water-heater pump. A small oil cylinder is located on the base of the device from which a pipe leads to a recording gage. A circular plate is attached to the end of the cylinder piston. This plate is grooved to receive different diameters of springs. Another circular plate is attached to the end of the screw which passes through the upper cross-member of the device. One of the side columns is graduated from 4 in. to 11 in., in order to determine the spring deflection under a certain load.

Ball seat water glass fitting

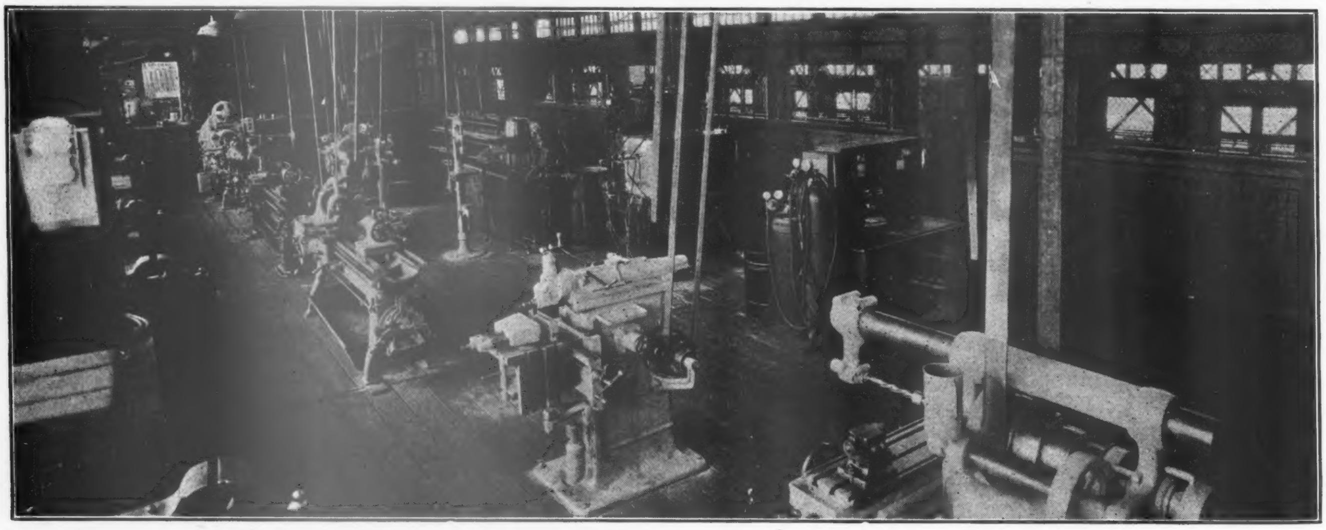
The Maine Central experienced considerable trouble with the old style water glass fitting, as it would not always line up correctly when drawn tight. This would cause the packing to be forced between the stem and its seat, thus partially plugging the hole leading into the water column and resulting in a false reading of the water level in the boiler. To overcome this trouble, the Maine Central has developed a ball seat water glass fitting, shown in Fig. 9. The ball seat fits into a ground joint in the bottom bonnet, thereby eliminating the necessity of a gasket. The ball joint and clearance between the stem and the packing nut, permits self-alinement of the water glass when the studs are not properly lined up.

Tool room practices*

By S. B. Chandler

Toolroom foreman, Pittsburgh shops, Kansas City Southern

WE seldom hear shop executives of this day and age saying that milling cutters are not needed for the successful operation of a miller, and they generally see to it that we have cutters. On the other hand, we may easily find executives who will candidly say that, while special tools such as jigs, dies, etc., may be a good thing, yet the shops are getting along very well without them and the results will not justify the expense of building or purchasing such tools. This may be a good argument sometimes, but, as a general rule, is about as reasonable as for a man to argue that it would not pay to get former cutters for the wheel lathe when the work could be done with a flange tool, if time enough were allowed for the job.



Kansas City Southern toolroom

I believe that the repair of steam locomotives can be handled on as efficient a business-basis as building locomotives. I know some who will say that the building of a considerable number at one time enables them to be built more cheaply. This is only partially true. Tools, jigs, dies, etc., which are the greatest mechanical factors in the business, can be used to an extent at least in locomotive repair work. It is safe to say that you could not go into an automobile factory and find a single

* From the Kansas City Southern Mechanical Department Bulletin.

hole laid off by a machinist with a scale and dividers, or a hole bored with a lathe tool that could be finished with a reamer. If you should ask the reason for this, the management would quickly tell you that they could not afford to lay holes by hand, or bore and caliper holes. Still, locomotive shops are doing this very thing today and they imagine they cannot afford jigs and other tools, or else think they do not need them. A hole laid out in a jig is laid out for all time, and you have the assurance of uniformity; whereas, hand work is relatively expensive, unreliable and often very inaccurate.

The toolroom in the average locomotive shop is sometimes looked upon as more or less of a useless expense, a place to put the old fellows, or cripples until they get on their feet again, just as a shelf is used to put things on that you are not going to need soon. The tool foreman is considered a handy fellow to have around when you want a nice little job done. Instead, the toolroom should be looked upon as the economic center of the shop, the place which aids materially in cutting production costs and making every dollar spent save two or more. It is safe to say that whenever a job is put up to the toolroom force for an improvement in methods, the improvement is forthcoming or a new toolroom force is needed.

It is money lost to manufacture standard tools that can be purchased on the open market much cheaper and better. We may think we can make them cheaper but when we consider the labor, material and overhead expense, the standard tool costs us much more. I believe it is preferable to take the time and material spent in the making of tools that can be bought on the open market and use it in making jigs and other labor-saving devices. We cannot get too many such tools in any machine shop.

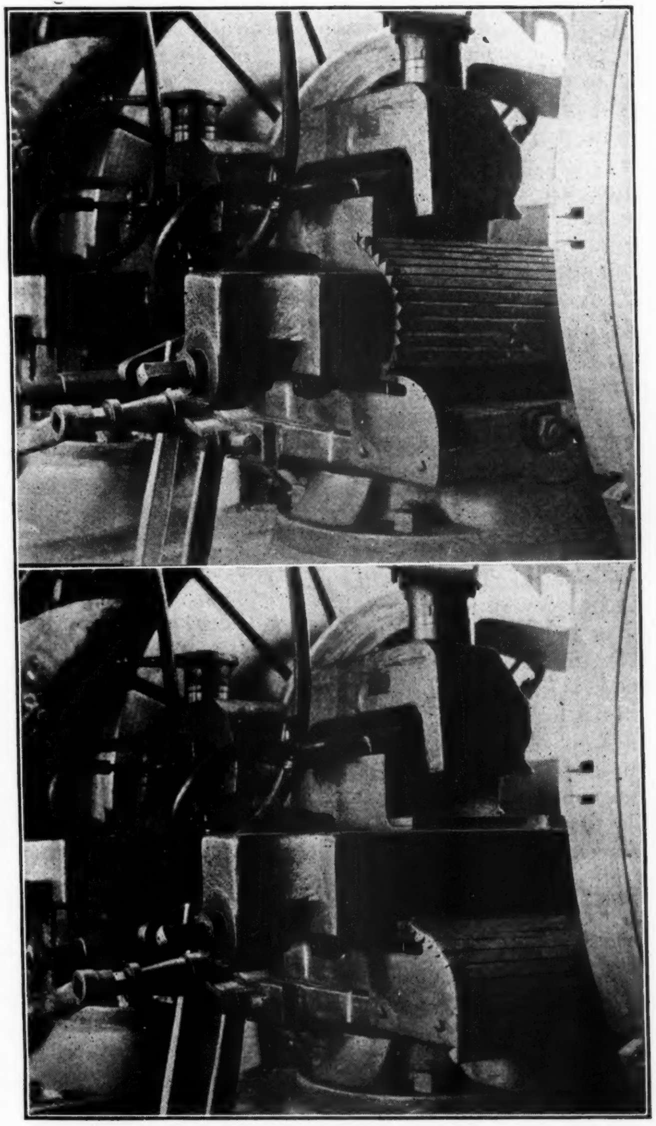
Pneumatic tools require much attention. No tools in the shop receive worse treatment and abuse than tools such as air hammers and air motors. They are often expected to operate at full capacity without any lubrication at all, to run smoothly on a mixture of water, compressed air, sand, pipe-line rust and bits of scrap rubber from the air hose lining. If they seem to slow down or show signs of being weak on this source of power, they are supposed to be helped along by receiving a few friendly blows from the operator's hand hammer. If the hammer cure doesn't work, it is about time for the operator to bring the tool to the toolroom man to be fixed.

A short time ago a large compound motor was brought in for repairs. The man who brought it in said it would not run. No wonder! It had had a blow with a hammer or had been thrown down on some hard object that made a dent in one of the cylinders. It required about two hours' hard and careful labor to get the piston out of the cylinder. This particular motor did not have a cylinder head which we could remove to drive the piston out. The piston was also equipped with a ball and socket joint at the toggle connection, and because of this construction we could not turn the piston in the cylinder.

Air hammers of the riveting or long-stroke type get a great deal of abuse that sometimes cannot be helped, but often, after the hammer is warm, it is laid down on the floor; care is not taken to keep the piston or plunger from falling out on the floor, which has a coating of tar or asphalt, and the piston being hot will cause the tar to stick to it. Then the operator will pick it up, wipe it off with a dirty glove—and the hammer gives poor service, later being delivered to toolroom with the remark, "The d—— thing is no good." You may figure out for yourself what was wrong. This is a very common occurrence and the cause of many stuck pistons.

Protective shield for a wheel lathe

THE shield shown in the two illustrations was made and installed primarily to prevent shavings from falling into the mechanism of the carriage on a wheel lathe. It is made of canvas to which strips of metal



Top: The shield folded back—Bottom: The shield in position to protect the mechanism

about 1 in. by 1/8 in. are riveted. The ends of each strip are pointed and turned down to provide additional covering at the ends. The cover is hinged to and rests on two curved plates screwed to the cross feed portion of the carriage.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

The tooling makes the machine

PARSONS, KANS.

TO THE EDITOR:

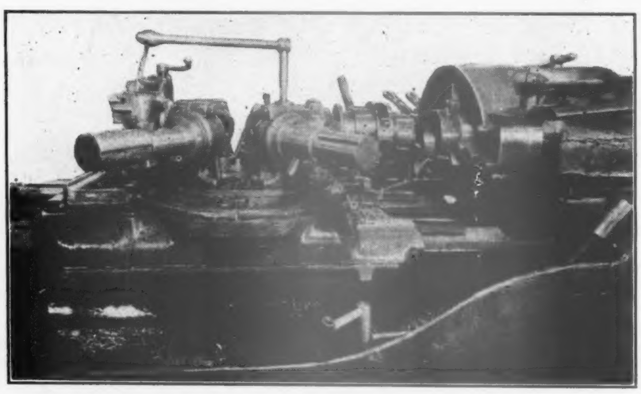
To-day, modern methods of production demand that the most efficient tools be used, and from day to day the tool problem changes. New ideas are constantly being put in practice. Have you ever studied the different machines in your shop to ascertain how much they are capable of doing? We all know that idle machines are expensive, and if they are not operating to the best advantage an appreciable loss results. When we can run them at full capacity, however, the maximum return on the investment is secured and substantial savings are effected.

Have you ever stopped to think how useless these machines would be without the proper tooling equipment? What is a machine tool? Nothing more than a mechanism to hold and drive a piece of work past a tool of some description, in order to make the work conform to some desired shape. The tool itself may be very small in size, but it has to transmit the power of the machine in which it is used. What is the productive part of the machine? Not the chuck or shifter, but the tool. It is not so important how large or how small a tool is, but is it efficient? In other words, does it do the work in the shortest possible time consistent with the quality required?

What do you think?

SOME Supervisors' Clubs have failed—others have made good to a surprising degree. Of how much value is a big, concrete and clearly understood objective—not for one meeting, or one season, but for the entire life work of the Club? What should this objective be?

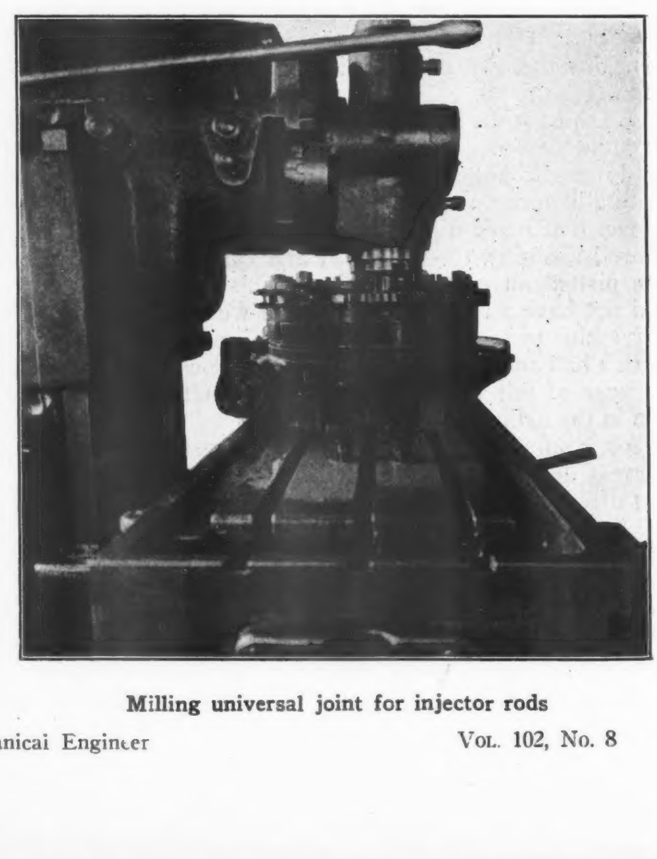
As examples of efficiency, I wish to mention just a few improved machine operations. Tank hose nuts were investigated at a certain shop and it was found that 30 minutes were required to complete one nut, floor to floor. After careful consideration, it was decided to make special tools to machine this part. The tools were made and put in operation on a turret lathe. Now the part is machined with a better finish and each part duplicated in exactly three minutes' time, floor to floor. The illustration shows the above set-up for machining tank hose nuts, consisting of a piloted boring bar, a piloted counter-boring bar and a collapsible tap for threading.



Set-up for machining tank hose nuts

Another improvement was effected on wrist-pin nuts, and greasecup bushings, with practically the same set-up as shown. The old method of machining wrist-pin nuts required 32 minutes. By the new method the floor to floor time is 10 minutes. The cutting time for boiler flue removal was reduced approximately one-third by designing the proper machine for the job. The machine, in addition to increasing the output, also reduced the amount of power for operation, saving both labor and power.

The other illustration shows what can be accomplished on a milling machine, this being a continuous milling operation on universal joints for injector rods, etc. The fixture is made in such a way that the parts can be removed and replaced while the machine is in operation, the device being secured to the rotary table of the machine. In operation, the parts revolve past a milling cutter which machines the inner sides of the jaws, the rods then being removed and rough parts replaced in the fixture. The cutter is mounted on a stub arbor and used in the vertical head of the machine. The parts are of forged



Milling universal joint for injector rods

steel. The old method of machining was to place the jaws, one at a time, in the regular vise furnished with the machine, which was a very slow operation.

Why should a railroad invest thousands of dollars in a machine and not get a fair return on the investment? How can there be an adequate return if the tool equipment is not carefully selected?

Whose is the tool problem and how can the man responsible prepare himself to meet conditions that confront him from day to day? The tool problem must be solved by the head of the tool department. It is essential that he keep up with advanced machining methods.

Problems like those mentioned above are to be discussed at the coming convention of the American Railway Tool Foremen's Association, Chicago, September 12 and 14, and it will be money well spent for the tool men to devote these three days to checking up tool practices at their respective shops and determine just what improvements can be effected.

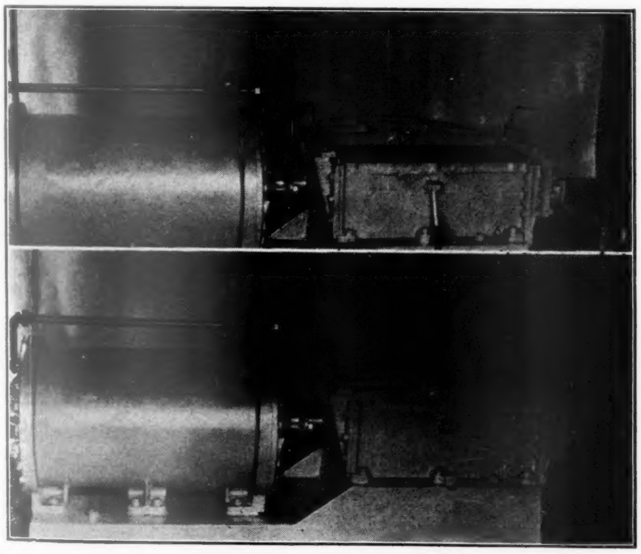
Better machines and better tool equipment are in store for the future, so get ready for them, and especially go slow in saying that any of the modern machine methods are not adaptable to railroad use.

W. R. MILLICAN,
Vice President, American Railway Tool Foremen's Association.

One method of handling hard grease

TO THE EDITOR: BATTLE CREEK, MICH.

On page 230 in the April issue of the *Railway Mechanical Engineer* information was requested as to the best way of pressing hard grease into suitable cakes



The grease press in the open and closed positions

or bricks for driving-box cellars of various sizes and shapes. The press designed especially for, and used for years for handling hard grease in the shops where the writer is employed, proved entirely inadequate for forming the harder improved non-moisture grease now available. When this grease was shipped in barrels, it was found necessary to chip it out with a special wide chisel and pneumatic hammer. Later, the manufacturers began to ship the grease in rectangular sizes of 30 in. by 11 in. by 5 in.

The illustration shows a press designed to hold two of these grease blocks. The walls of the press are made so that a small amount of low-pressure steam can circulate in the box. The lid is clamped in place, and 90 lb. air pressure is turned into the 20-in. cylinder. With this combination air pressure and steam heat, the hardest grease will extrude at a very rapid rate. The largest cakes can be passed through the machine in less than one minute. A READER.

Testing air brakes—An answer

NEW HAVEN, CONN.

TO THE EDITOR:

W. A. Burnham asked a question which was published in the March, 1928, issue of the *Railway Mechanical Engineer* in regard to testing air brakes. There are several important parts of a locomotive that may have caused the defect as explained by Mr. Burnham. For instance the compressor, compressor governor, feed valve, steam pressure and brake valve. The yard testing device may also be considered.

If the steam pressure is not high enough it will retard the compressor and keep the main reservoir pressure so low that it can not build up the standard brake-pipe pressure. A stopped-up vent port in the compressor governor might hold up the working of the compressor, and reduce the main reservoir pressure. The compressor itself may retard the main reservoir pressure. A wedged inlet valve would cause the pressure to be blown back to the atmosphere on the return stroke of the low-pressure cylinder piston.

A leaky equalizing piston valve will cause a leak at the brake pipe service exhaust while the brake valve is in release or running position. The feed valve can cause much trouble, especially when the brake pipe pressure is nearing its required pressure. This is usually caused by a loosely fitting piston or a sticky regulating valve.

The condition referred to by Mr. Burnham—"the brakes keep applying and releasing"—can be caused by the non-uniform main reservoir pressure that might exist due to the above mentioned defects. On the other hand this could be caused by an overcharged brake pipe system, assuming that the yard testing device was not functioning properly.

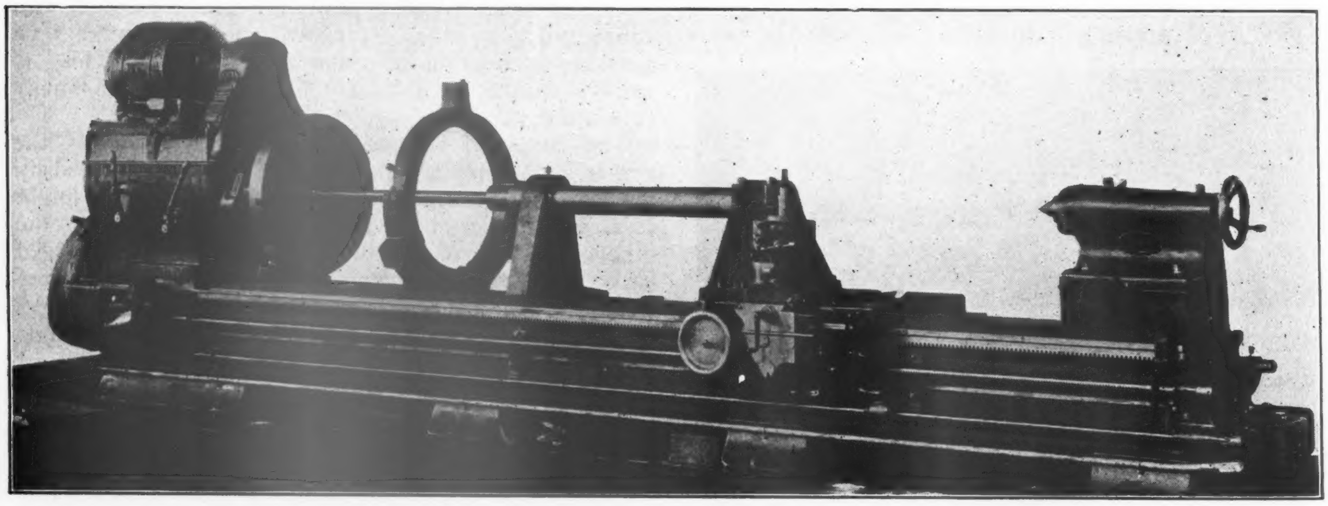
The locomotive could, through the proper manipulation of the brake valve, cause the brakes to apply and release under such a condition. It would be necessary to reduce the brake pipe pressure below the standard before a brake test could be made. It is customary, when charging up a train, to leave the brake valve handle in release position until the pressure has been built up to within five pounds of the standard. The handle is then returned to the running position for about three seconds on an 80-car train, and then thrown back to release position to kick off any brakes that have applied due to an overcharge, which is often the case when H-triple valves are on the head end of the train. The last five pounds are built up through the feed valve.

On an 80-car train, a leakage of from 5 to 12 lb. per minute is most always to be found, when the brake valve is placed in lap position, to ascertain the leakage. If the leakage is too great it will cause the brakes to apply. Often the engineman sees that he cannot get the required pressure with the feed valve set at 70 lb. and he jumps it up to 75 lb., which in most cases enables him to maintain 70-lb. brake pipe pressure. This may account for the fact that he finally gets the required pressure. JAMES MCDONNELL.

Engine lathe with boring bar attachment

A foreign locomotive manufacturer has purchased from the Niles Tool Works Company, Hamilton, Ohio, a 36-in. by 22-ft. Niles engine lathe equipped with a boring bar attachment for turning, boring and recessing large bushings for three-cylinder locomotive cylinders.

In this country, the general practice would be to perform these operations on a vertical boring and turning mill, but the design of the bushings and certain other factors in this case have made it more advantageous to revert to an engine lathe.



A Niles engine lathe equipped with a boring bar attachment for machining the cylinder bushings of three-cylinder locomotives

The machine is a standard Niles Time Saver lathe with the addition of a boring bar bracket bolted across the wings of the carriage supporting a heavy boring bar. The boring bar has an outer support and a pilot bar carried in a bushing on the spindle nose. The end of the bar is fitted with a key to which a boring head is secured. A large center rest is also furnished.

The bushings are about 40 in. long with an outside diameter of 27½ in. and a bore of 25½ in. They are cast with a flange for chucking on the face-plate. After chucking, a light cut is taken on the outside diameter to provide a bearing for the large center rest. The casting is then ready for the boring operation. After boring is completed, the bushing is mounted on an arbor between the centers and the excessive length of the bushing and flange cut off, the outside diameter turned, both ends faced and the recesses machined in both ends, all in one set-up

The process requires two operations, but it is claimed that the results secured more than offset the extra time consumed.

Pure Iron Plates.—Complete information concerning the physical properties, weldability, rust resistance and uniformity of Armco ingot iron is contained in the 20-page booklet of the American Rolling Mill Company, Middletown, Ohio. Armco pure iron plates are now available in all commercial sizes and thicknesses.

Superheater Units.—Superheater units, remanufactured vs. repaired, are discussed in a booklet recently issued by the Superheater Company, 17 East Forty-second Street, New York. The booklet points out that damaged parts can be completely remanufactured at the Elesco plant, with original dimensions retained throughout, new return bends, new ball ends, and new bands and supports.

A paint for protecting metallic and other surfaces

A SATISFACTORY protection for metallic and other surfaces from the influences of the elements, moisture, dampness and chemical fumes is promised by the use of Subox, a metallic lead coating now being imported by Subox, Inc., 220 Church street, New York. This material is based on a pigment of suboxide of lead, PB_2O, which, through an electrochemical process, is obtained in such a high degree of dispersion as to be mainly colloidal. A lasting suspension in the vehicle is obtained, previous oxidation is prevented.

Through great chemical activity, a metallic lead coating is finally established, so closely imbedded in the underlying surface as to act as filler and sealer. It is impervious to moisture and resists chemical fumes as well as the elements. Its service when exposed to sulphuric or ammonia fumes is particularly satisfactory. On account of its chemical changes, the Subox coating increases in efficiency through weathering and exposure and is independent of the vehicle for its life.

The Subox coating is distinguished by adhesion, penetration, elasticity, density and is said not to peel, chip or crack. Subox is obtainable in only dark grey. It is delivered ready for use and is equally suitable as primer or top coat, for use by itself or in conjunction with other materials on new construction or for general maintenance. Applied over firm rust, it is said to retard further corrosion to a remarkable extent. It also offers satisfactory adhesion to galvanized surfaces, provided they are duly pickled or weathered.

The main use of Subox is for structures and equipment exposed to the elements. It can, however, also be used for inside work, particularly where dampness, moisture or fumes have to be contended with. When used as a bridge paint, it is particularly noteworthy that it furnishes adequate protection with the addition of a much smaller amount of weight than is expected of lead, or zinc paints. On rolling stock, it is recommended particularly for such places as are hard to reach, where its long life makes it attractive.

Niles two-spindle rod boring machine

A HEAVY type, two-spindle rod boring machine equipped with a number of attachments, making it universally adaptable for all boring and facing operations on locomotive connecting rods, has been completed for a western railroad by the Niles Tool Works Company, Hamilton, Ohio.

Each spindle is driven by its own variable-speed, direct-current, 15-hp. motor, giving spindle speeds ranging from 8 to 140 r.p.m. The motors are mounted back of the crossrail, one on each end, and are connected to the spindle through gear boxes. The final drive of the spindle is by a steel worm and bronze worm wheel. The worms are provided with ball thrust bearings, making a smooth drive, well suited for heavy trepanning.

The spindles are of high-carbon, hammered steel with a diameter of 5½ in. at the driving-gear end and 8 in. at the opposite end. They are counter-weighted and can be adjusted by hand with conveniently located handwheels. The lower ends of the spindles are fitted for No. 7 Morse taper sockets.

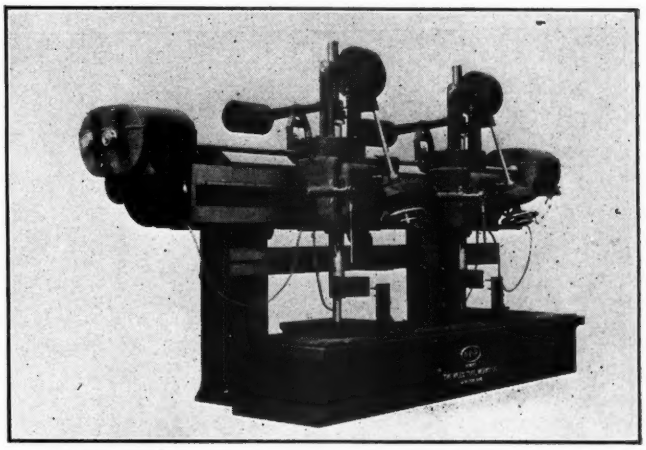
The vertical travel of the spindles is 22 in. and, in addition to the rapid hand adjustment, they are provided with five hand feed and six automatic geared feeds, ranging from .005 to .165 per revolution.

The spindle saddles are adjusted along the rail by a rack and pinion and have a minimum of 36 in. and a maximum distance of 14 ft. 2 in. between the spindle centers. The maximum distance from the top of the table to the end of the spindle is 30 in.

The main table is provided with tee-slots for clamping the work and a trough to catch the cutting fluid and return it to the tank in the base. Two independently driven pumps are used for circulating the cutting fluid.

A lower rail support is bolted to the housings for steadying the ends of the spindles when using trepanning cutters or box tools. The spindle guides may be moved out of the way and the rail elevated so as not to interfere with the use of pilot bars.

Two movable work tables are also provided with bushed holes in their surfaces. These are used in connection with boring bars with pilots at their lower ends.



The Niles two-spindle heavy duty rod boring machine

These tables are tongued and grooved to the main table and have a means for clamping in position.

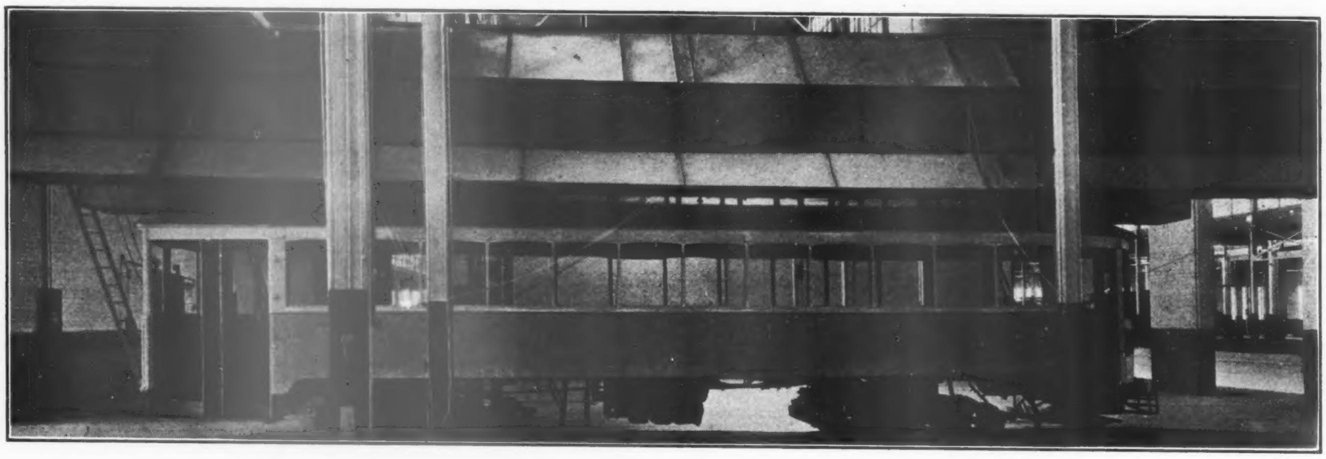
For machining bosses on certain types of rods, each spindle is equipped with a facing head provided with a pilot bar which is guided by a bushing in the movable work table. The facing-head feed is of the star type.

AMERICAN MULTIPLE THROTTLE.—The general construction of the American multiple throttle is described and its advantages explained in Bulletin No. 3 issued by the American Throttle Company, 17 East Forty-second Street, New York. Typical application layouts with both the Type A and Type E superheaters are shown.

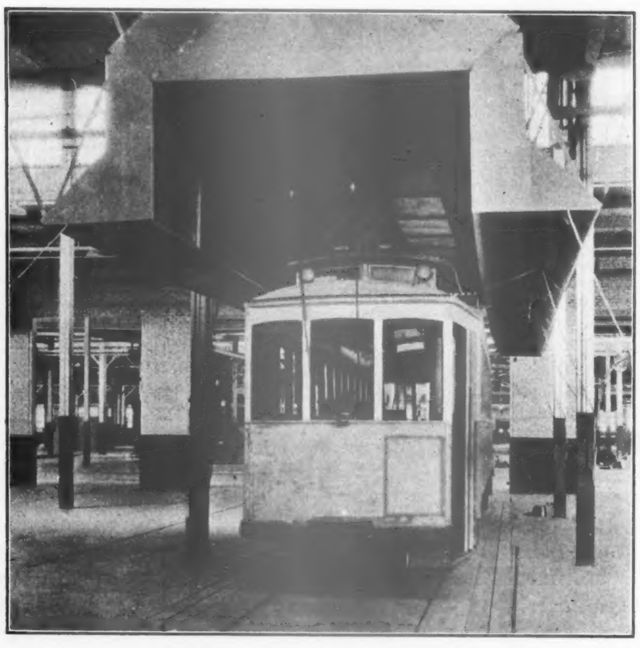
Exhaust system for painting railway cars

THE constant increase in the use of lacquer as a finishing material for the exterior of railway passenger cars, and the use of high-speed spray guns for its application, has brought about a condition which requires a more effective exhaust system than has been used in the past. Under the old system of painting passenger cars, in which the slower drying materials were used and the speed of production was not so seriously considered, the requirements of the exhaust systems were not so rigid as they are under the more modern finishing systems.

The control of air currents is such a delicate matter that considerable research work has been required in developing an exhaust system of sufficient size to handle units as large as passenger cars. The DeVilbiss Company, Toledo, Ohio, after a considerable period of development, has brought out a paint exhaust system for handling large units. Both blowers and exhaust fans are used. The draft is induced from the outside atmosphere, forced up from the floor and collects the spray vapor as it passes up the side of the car. The air is picked up from this point by overhead suction fans which force it out through the roof to the outside of the building. The input air ducts in the floor are parallel to the tracks, as can be seen in the illustrations. They are so arranged with vents and baffles that the air is evenly distributed on both sides for the full length of the car. These vents and baffles are arranged in such a manner that the air is forced out in a direct line along the side of the car, forming a wall of clean, fresh air, taken from the outside atmosphere, between the spray operator and the car, which gives maximum protection at all times to the workmen.



The paint exhaust system as installed in the shops of a street railway company



End view of the installation, showing the air duct outlets in the floor parallel to the tracks

The canopy exhaust overhead is provided with special DeVilbiss 42-in. exhaust fans. These fans and the motors operating them are, whenever possible, located on the roof of the building and protected from the weather by metal housings. This is a further safeguard and protection against any possible fire hazard.

The canopy is adequately equipped with sprinklers. Both the closed head and the open head types are used. The latter is for flushing purposes. The hinged panels on the undersides of the canopy are so arranged that they can be moved by small ropes and pulleys. This enables the operator to work on top of the car with the same protection that he has working on the sides.

The equipment illustrated is installed in the shops of the Cincinnati Street Railway Company.

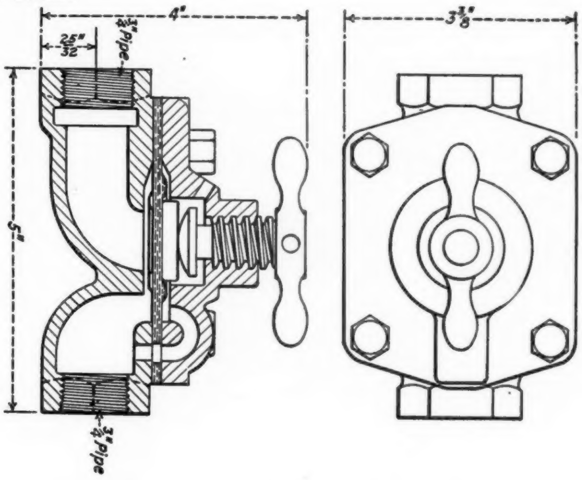
"1928 Locomotive Progress."—This is the title of a 52-page brochure issued by the Superheater Company, 17 East Forty-second Street, New York, illustrating a few representative examples of locomotives equipped with the Elesco superheater. Among the locomotives illustrated are the Hudson 4-6-4 type locomotive for the New York Central, the three-cylinder Pacific type locomotive for the Mexican Railway, the Pacific type locomotive for the Canadian Pacific, the Northern Pacific 4-8-4 type locomotive, the Union Pacific three-cylinder 4-12-2 type locomotive, the simple articulated 2-8-8-2 type locomotive for the Denver & Rio Grande Western, and the Chesapeake 2-8-8-2 type locomotive for the Chesapeake & Ohio.

Diaphragm cut off valves

THE Westinghouse Air Brake Company, Wilmerding, Pa., has recently placed on the market a line of diaphragm cut off valves designed primarily for replacing the usual key type of cock on triple valve test racks to reduce the possibility of leakage and assure more accurate testing. They are, however, suitable for other purposes where the advantages of tightness, longer life and cheaper maintenance may be essential.

The valve comprises a body and cap between which is clamped a flexible diaphragm that serves as a valve to control the passage through the valve when actuated by a threaded stem and T-nandle. The diaphragm is adapted to form a seal either on the cap or on the body as the case may be, seat rings being formed on the upper surface and lower surfaces for this purpose.

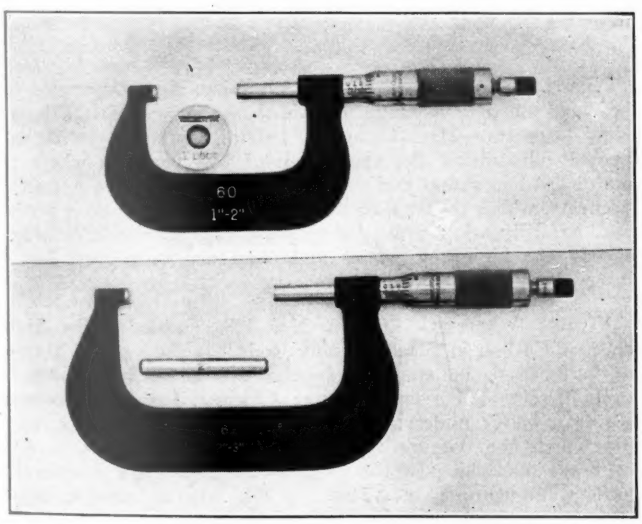
When the handle is turned clockwise the diaphragm is forced downward against a seat on the body, thereby preventing flow of air through the valve. Only a slight pressure on the screw is required to accomplish a bottle-tight closure. When the handle is turned counter clockwise, the force holding the diaphragm down is relieved. Air pressure underneath then lifts the diaphragm from its seat on the body, thereby opening the air passage and seals it against the cap to prevent leakage around the stem.



Diaphragm cut-off valve used on triple valve test racks to reduce leaking and assure accurate testing

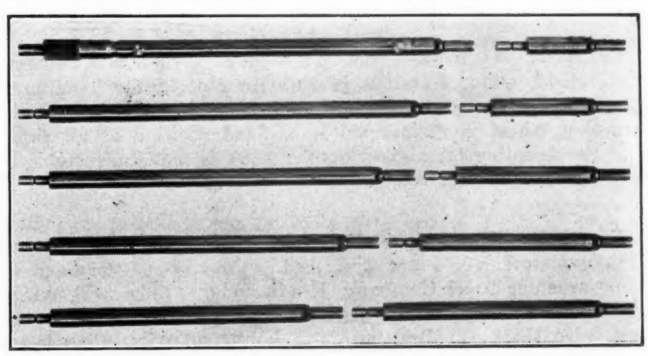
Inside and outside micrometer calipers

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has placed on the market a new tubular inside micrometer and two new designs of micrometer calipers. The tubular micrometers are made in three sizes to measure, respectively, from 12 in. to 22 in., 22 in. to 32 in., and 32 in. to 42 in., by thousandths. The range of measurements of each tool is obtained by ten changeable anvils of different lengths. The shoulders of the anvils fit against the shoulder of the micrometer head, insuring positive adjustment and accurate measurements. The anvils can be changed easily and are held in place positively by a clamp-screw fitting into a vee groove.



The Brown & Sharpe Nos. 60 and 62 micrometer calipers

Because of their tabular construction, these micrometers are light and easy to handle. They can be quickly and easily adjusted and can be locked at any reading. The measuring points are hardened and the faces are ground on a radius, which adapts them especially for measuring parallel or curved surfaces.



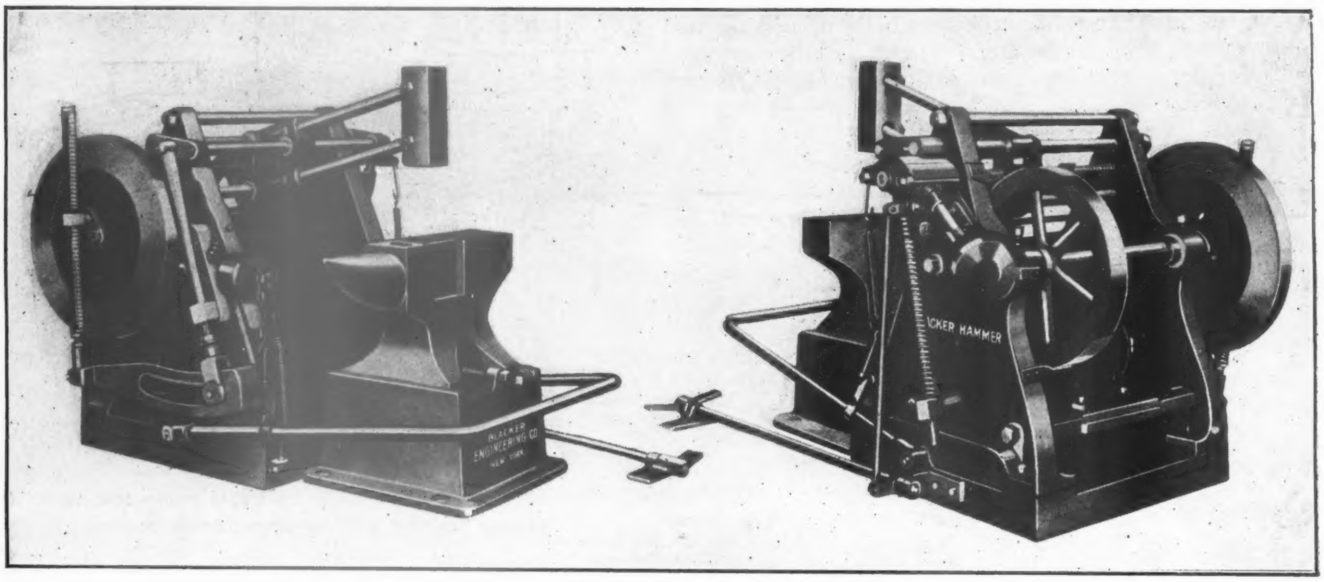
The No. 276 tubular micrometers for measuring from 22 in. to 42 in. by thousandths

The micrometer calipers are graduated to read in thousandths of an inch, or they may be obtained to read in hundredths of a millimetre. The No. 60 measures from 1 in. to 2 in., and the No. 62 measures from 2 in. to 3 in. Both have solid anvils and a simple adjustment for wear of the measuring surfaces. In design, they are similar to the present Brown & Sharpe micrometer calipers Nos. 61 and 63, except that they do not have clamp rings. They may be furnished with or without standards and with or without ratchet stops.

Blacker Model B blacksmith hammer

A REDESIGNED Model B blacksmith hammer, designed for general utility and jobbing blacksmithing work, has been placed on the market by the Blacker Engineering Company, Grand Central Terminal, New York. Although retaining all the features common to earlier designs, it is a larger and heavier machine throughout. Thrust bearings have been fitted to the control mechanism and a complete rearrangement of the motor drive has resulted in the compact unit shown.

This power-operated hammer will strike 140 blows a minute which are several times as heavy as hand sledge blows. It works upon an ordinary 500-lb. anvil, and the usual hand forging tools are used. A link motion permits positive control of the blows, and the head may be traversed along the anvil face.



A front and a rear view of the Blacker Model B blacksmith hammer

The force of the blow is regulated by the treadle which extends around the anvil base. A winged foot lever controls the gears which cause the head to traverse. Double shouldering operations are performed on the central "cut-out" placed in front of the anvil. The anvil is fitted to its block with adjusting screws. The play of the hammer is taken up by the flywheel springs.

* * * *

GRINDING MACHINE.—The Thompson Grinder Company, Springfield, Ohio, describes in Bulletin No. 18 the Thompson 12-in. by 36-in. universal grinding machine, in which the grinding wheel is maintained in a fixed position at all times and the grinding table carrying the work is made adjustable to any desired position relative to the wheel.

STAINLESS STEEL.—The physical properties of Carpenter stainless steel No. 5 are described in the six-page folder of the Carpenter Steel Company, Reading, Pa. This steel, which can be machined at high speeds with regular shop tools, is used for valve seats, spindles, bushings, bolts and nuts, micrometer frames, etc.

TAPS, DIES, SCREW PLATES.—Catalogue No. 32 of the S. W. Card Manufacturing Company, 62 Reade Street, New York, contains detailed information bearing directly on standardization of design, dimensions, tolerances, drill sizes, etc. Taps and dies are listed in Whitworth, British Standard Fine and British Association forms of thread, as well as in the metric form.

TURRET LATHES.—The 1L and 2L high production turret lathes are illustrated and described in catalogue H.P.1 issued by the Gisholt Machine Company, Madison, Wis. These machines are the smaller units of a line of heavy duty turret lathes, ranging in swing up to 34 in. and in spindle bore up to 12¼ in.

NEW DEPARTURE BALL BEARINGS.—What New Departure ball bearings mean to machine tools is the subject discussed by the New Departure Mfg. Company, Bristol, Conn., in its 20-page booklet illustrating the application of ball bearings where the major load is radial and axial location need not be extremely accurate, where thrust load of more or less magnitude is present and axial location must be accurately maintained, or where speeds are high and where maximum accuracy must be obtained both radially and axially.

FUSION WELDING.—Bulletin No. 128, entitled "The Influence of Carbon in Steel Welding Rods," is the first of a series of bulletins to be published by the Fusion Welding Corporation, 103rd and Torrence Avenue, Chicago, for the purpose of giving a better understanding of some of the phases of welding which are obscure and on which there have been many different opinions. In the first several issues the effects that carbon, manganese, etc., have on the flow of welding metal and the resulting deposits, will be discussed.

SPEED INDICATOR.—The general characteristics of the Western railway speed indicator—an electrical device for indicating the speed of steam and electric locomotives, private and business cars, dynamometer test cars, rail motor cars, etc.—are described in the supplement to Bulletin No. 4000 of the Weston Electrical Instrument Company, Newark, N. J. The device consists of a magneto generator, driven from a truck axle and generating a voltage directly proportional to its speed, connected by means of cables to a voltmeter indicator calibrated in miles per hour.

News of the Month

The Longest Train?

What is thought to be the longest train with the greatest number of cars ever operated by any railroad with one locomotive recently was run west out of Victoria, Va., on the Virginian for Roanoke. The train proceeded to Roanoke (123 miles) without the assistance of a pusher engine in 7 hrs. 35 min., including all delays, passing over the Stone mountain range of the Blue Ridge Mountains where there is a grade of 0.6 per cent. The train was 8,482 ft. long, or more than a mile and a half, and weighed 4,573 tons. It was delayed 32 min. en route meeting and allowing other trains to pass, with practically no delay to other trains. The train consisted of 189 empty coal cars, 8 empty box cars, 2 cars of gasoline, one car of steel and one car of asphalt.

The type of locomotive used is a 2-10-10-2 Mallet which is handling eastbound in loads from Roanoke to Victoria trains of 14,000 tons, averaging from 125 to 160 cars and making the run in about 12 hrs.

Supplement No. 1 to the 1927 Rules of Interchange effective January 1, 1928

Circular No. D. V.-593 issued by the Mechanical Division of the A. R. A. makes mention of the fact that a supplement to the current Rules of Interchange has been prepared by the Arbitration Committee and the Committee on Prices for Labor and Material, which includes a new Rule 26 and modifications of Rules 3, 9, 24, 36, 66, 74, 84, 85, 86, 101, 107, 108, 111, 112 and 120 of the freight car code and Rule 22 of the passenger car code.

This supplement can be obtained from the office of Secretary Hawthorne, 1426 Manhattan building, Chicago. Copies will be forwarded immediately to all purchasers of the original book in the same number as furnished, without additional charge or the necessity of making a requisition to cover.

Baldwin Ceremonies at Eddystone

An elaborate program commemorating the removal of the Baldwin Locomotive Works from Broad and Spring Garden streets in Philadelphia, to Eddystone, Pa., was held at Eddystone on June 28. A large grandstand was erected adjacent to the new eight-story administration building and was filled with employees, and a great number of railroad, railway supply and public representatives from all parts of the country. Special trains for the guests were operated from New York, Philadelphia, and from Atlantic City, many of the members of the Mechanical Division of the American Railway Association coming from the latter point.

Samuel M. Vauclain, president of the company, presided at the ceremony.

Revised pages for Manual of Standard and Recommended Practice

According to Circular No. D. V.-594 issued by the Mechanical Division of the A.R.A., revised loose-leaf pages for the Manual of Standard and Recommended Practice of the Mechanical Division, American Railway Association, covering revisions and additions as the result of letter ballot approval of recommendations of committees for 1927, are now ready for distribution. These revisions include, in addition to the changes and additions to the standard and recommended practice, revision of title page, general index and indexes of the sections affected.

A complete set of revised pages to bring the manual up to date, will be supplied on requisitions addressed to the office of the secretary, 1426 Manhattan building, Chicago.

Revised loose leaf pages to the supplement to the manual, covering revisions and additions as the result of letter ballot approval of recommendations by the Committee on Car Construction for 1927, are in the course of preparation and will be available for distribution about September 1.

The Canadian National has ordered eight 2-10-4 type locomotives from the American Locomotive Company, for service on the section of the Central Vermont north of Point River Junction, Vt., to the Canadian border. These locomotives will weigh 415,000 lb., and, with tender, will have a total weight of 682,500 lb. The length of locomotive and tender will be 83 ft. They will have a tractive effort of 72,500 lb. without booster and 86,000 lb. with booster.

Meetings and Conventions

National Metal Exposition to be Held at Philadelphia

The National Metal Exposition to be held in Philadelphia the week of October 8, under the Auspices of the American Society for Steel Treating, demonstrates at this early date that it will be a fitting companion to the nine previous expositions.

The National Metal Exposition will again be a well balanced factory equipment show and will contain all of the complete lines previously exhibited, covering everything in both the ferrous and non-ferrous field: Heat treating equipment; small tools; machinery; forging equipment; inspection, handling and welding equipment.

Approximately 10,000 sq. ft. will be devoted to an exhibit of welding supplies and equipment. A definite portion of the Commercial Museum has been set aside for this feature of the exhibit and is to be carried on in co-operation and under the auspices of the American Welding Society which association will hold its annual fall meeting in Philadelphia the same week as the exposition.

The Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers will again hold their fall meeting at Philadelphia during the same week.

Meeting of Machine Tool Congress

A joint meeting of the Machine Shop Practice Division of the American Society of Mechanical Engineers and of the Machine Tool Congress will be held at Cincinnati, Ohio, September 24 to 27, inclusive. Questions of particular interest to users and builders of machine tools will be discussed at this meeting. Tentative arrangements contemplate a visit to the continuous rolling mill plant of the American Rolling Mill Company at Ashland, Ky., to which point those attending the meeting will be taken by an Ohio river steamer.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting Windsor hotel, Montreal, September 11-13.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Annual convention Hotel Sherman, Chicago, September 12-14.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio. Annual convention October 8-12, Benjamin Franklin Hotel, Philadelphia, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York. Fall meeting October 8-12 Bellevue-Stratford Hotel, Philadelphia.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, October 23-26, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—A. J. Walsh, 5874 Plymouth Apt. 18, St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Courtlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—(See Railway Car Department Officers' Association.)

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 21-22, 1928.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Hotel Sherman, Chicago, September 18-21, 1928.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Convention September 11-13, Hotel Statler, St. Louis, Mo.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205 Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—E. H. Weigman, master car builder, the Kansas City Southern, Pittsburg, Kan. Annual meeting August 4, 5 and 6 at Galveston, Tex.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month. Terminal Hotel bldg., Fort Worth, Tex.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.—Annual meeting Hotel Sherman, Chicago, September 25 to 28 inclusive.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

LEWIS THOMAS has been appointed district sales manager at Chicago, for the Q & C Company.

GEORGE J. LYNCH, assistant district manager of the Chicago Pneumatic Tool Company, New York, has been appointed district sales manager, with headquarters at St. Louis, Mo.

EMERY M. ATKINS has been promoted to assistant general storekeeper of the Louisville & Nashville, with headquarters at South Louisville, Ky.

G. T. VANSCHAICK, president of the Universal Railway Supply Company, Chicago, died on July 8, following an automobile accident near Eagle River, Wis.

WILLIAM H. EAST has joined the sales organization of The Pyle-National Company as a sales engineer, with headquarters in the Straus building, Chicago.

CHARLES T. STRAWBRIDGE, vice-president of the Bass Foundry & Machine Company, Fort Wayne, Ind., died at his home in Fort Wayne on June 10.

BURTON MUDGE, executive vice-president of the Bradford Corporation, New York, has been elected first vice-president of this company.

THE CHICAGO SALES OFFICE of the Joseph Dixon Crucible Company is now located in the Builders building, Wacker Drive and LaSalle street.

THE PITTSBURGH TESTING LABORATORY has opened an office in Boston, Mass., at 101 Tremont street, in charge of Donald L. Macdonald. Mr. Macdonald was formerly connected with the engineering department of Stone & Webster.

W. G. EDMONDSON has resigned as assistant engineer of motive power of the Reading Company, and has been appointed works manager at the plant of the American Abrasive Metals Company, Irvington, New Jersey.

KENNETH M. BAILEY, has been appointed technical sales representative of the Curtin-Howe Corporation, wood preservation engineers. Mr. Bailey's headquarters are in the N. O. Bank building, New Orleans, La.

THE TRUSCON STEEL COMPANY, Youngstown, Ohio, has purchased the Hydraulic Pressed Steel Corporation, Cleveland, Ohio, and will operate it as its pressed steel division. The entire plant is being completely modernized.

WEBB G. KRAUSER, representing the Union Draft Gear Company and the Universal Draft Gear Attachment Company, has removed his office from 120 St. James street, to 360 St. James street, Montreal, Que.

K. J. BURNS, representative of the Youngstown Sheet & Tube Company, has been promoted to district sales agent in charge of the Youngstown, O., district sales office, to succeed Myron S. Curtis, resigned.

INGERSOLL-RAND, INC., has succeeded the Ingersoll-Rand Drill Company, 314 North Broadway, St. Louis, Mo. A branch operating under the St. Louis office has been opened at 226 West A street, Picher, Okla.

WILLIAM H. MOORE, formerly representative of the Metal & Thermit Corporation, with headquarters at Chicago, has been appointed sales manager of the W & B Company and the Burnside Steel Foundry Company, Chicago.

F. A. ERNST, formerly representative of the American Rolling Mill Company, with headquarters at Chicago, has been appointed assistant district sales manager of the Inland Steel Company with headquarters at St. Louis, Mo.

WILLIAMS ROBERT QUINN, designer of fuel oil burning equipment, died suddenly at New York, on April 12. Mr. Quinn was for several years representative of the Combustion Engineering Corporation at San Francisco.

C. IRVING DWINELL, who was sales engineer for the General Electric Company at Providence, R. I., has been appointed manager of the Boston, Mass., branch at 514 Atlantic avenue, of the United States Electrical Tool Company.

THEODORE BERAN, commercial vice-president of the General Electric Company in charge of the New York district, has retired. Mr. Beran had been manager of the New York district since 1903, and was elected vice-president in 1926.

THE CHICAGO OFFICE of the Reading Iron Company, Reading, Pa., is now located at 205 West Wacker Drive, instead of 449 Conway building, Chicago. This office is under the direction of R. A. Griffin, district sales representative.

THE FALLS HOLLOW STAYBOLT COMPANY, Cuyahoga Falls, Ohio, manufacturer of both rolled hollow and solid staybolt iron, is now represented in New York by J. C. Tucker of Charles Hubbard & Co., 17 Battery Place, New York City.

PHILLIP F. WALKLEY, assistant treasurer of the American Locomotive Company, New York, died at the age of 43, on July 15, in the Morningside hospital, Montclair, N. J., from the effects of injuries received in an automobile accident one week previous.

MAURICE N. TRAINER and EDWARD BARRETT SMITH have been appointed assistant vice-presidents of the American Brake Shoe & Foundry Company, New York, reporting to William S. McGowan, vice-president in charge of eastern and southern sales department.

THE FIRM OF Rank & Goodell, 906 Merchants National Bank building, St. Paul, Minn., manufacturers agents, handling railway supplies, has been dissolved, and the business taken over by George H. Goodell and Carl M. Hoppe under the firm name of Goodell & Hoppe.

DAVID NEWHALL has been appointed manager of the Philadelphia branch of the Manhattan Rubber Manufacturing Company, Passaic, N. J. Mr. Newhall was formerly manager of sales of freight cars and auxiliary locomotives of the Bethlehem Steel Company, at New York.

THE OKONITE COMPANY, 501 Fifth avenue, New York, celebrated its fiftieth anniversary June 27 at the Engineers' Club, New York. A banquet was held which, in addition to celebrating the "Golden Jubilee," was in the nature of a testimonial to H. Durant Cheever, president of the organization, who has been with the Okonite Company for 40 years.

D. S. MAIR, manager of the Houston, Tex., office of Joseph T. Ryerson & Sons, Inc., has resigned to organize the D. S. Mair Machine Company, Houston, Tex. He will handle the sales of the bolt and pipe threading machines and the taps of the Landis Machine Company and the machine tools of the Ryerson Company.

ARCHIBALD STURROCK, who was formerly assistant superintendent of motive power of the Western lines of the Canadian Pacific at Winnipeg, Man., has been appointed master mechanic of the Esquimalt & Nanaimo, with headquarters at Victoria, B. C., succeeding Walter Byrd, who has retired from active service.

JOSEPH S. KING, JR., engineer of tests of the Bradford Corporation, has resigned to become sales representative of the Forsyth Draft Gear Corporation, with headquarters at 39 South La Salle Street, Chicago. Mr. King, prior to entering the Bradford Corporation, was employed in the test bureau of the Baltimore & Ohio.

H. S. BRAUTIGAM, formerly asistant to master car builder of the Chicago, Milwaukee & St. Paul, has been appointed district representative in the southwest, with office at 501 Shell building, St. Louis, Mo., for the Allegheny Steel Company, Brackenridge, Pa. Mr. Brautigam is the author of the book "United States Safety Appliances."

THE GEOMETRIC TOOL COMPANY, New Haven, Conn., has appointed Ralph Simpson to handle the sales and servicing of Geometric tools and equipment in Eastern New England, comprising the States of Maine, New Hampshire, Rhode Island and Eastern Massachusetts. Mr. Simpson was formerly sales-manager of the Stockbridge Machine Company.

THE ARDCO MANUFACTURING COMPANY, Hoboken, N. J., is the successor of the B. & S. Manufacturing Corporation; H. L. Wittpenn is president and Charles Stern vice-president. The company has appointed the following representatives: M. C. M. Hatch, Boston, Mass.; T. Z. Railway Equipment Company, Chicago, and Frank R. De Brun, San Francisco, Cal.

L. E. HASSMAN has been appointed district sales manager of the Q & C Company, with headquarters at St. Louis, Mo. He received his education in the public schools and in the Friends Central School, Philadelphia. All of his railroad service was with the Illinois Central, Mr. Hassman having entered the employ of this company as machinist apprentice. He served successively as machinist, and draftsman, Chicago; roundhouse foreman, Carbondale, Ill.; general foreman, East St. Louis, and in February, 1906, was appointed master mechanic at Clinton, Ill. In February, 1912, he left railroad service to go with the railroad sales department of the Johns-Manville Company, with headquarters at New Orleans. In February, 1917, he was appointed southwestern representative of Brown & Company, Inc., at St. Louis, where he remained until the company dissolved in June, 1924. Mr. Hassman then entered the service of the Ulster Iron Works in the same capacity, with headquarters at St. Louis, remaining with that company until his appointment as district sales manager of the Q & C Company.

L. E. Hassman

THE PARTNERSHIP INTEREST of W. O. Washburn in the American Hoist & Derrick Company has been purchased and taken over by Frank J. Johnson, the senior partner and one of the founders. The business will be continued as the American Hoist & Derrick Company under the form of a corporation with F. J. Johnson, as president and treasurer, Howard S. Johnson, vice-president in charge of sales and Frederic Crosby, as vice-president in charge of production. No announcement has been made by Mr. Washburn as to what his future business connections may be.

MANNING, MAXWELL & MOORE, INC., New York, has purchased the American Schaeffer & Budenberg Corporation of Brooklyn, N. Y., and Worcester, Mass., from Ralph Jonas and associates. The newly acquired company, founded in 1851, manufactures industrial instruments. The business of this company will be co-ordinated with that of the Consolidated Ashcroft Hancock Company, Inc., manufacturer of valves, indicating and recording instruments, which is owned by Manning, Maxwell & Moore. The operation of the Brooklyn and Worcester factories of American Schaeffer & Budenberg Corporation will be taken over by Manning, Maxwell & Moore.

Personal Mention

General

J. Lee, chief draftsman of the motive power department of the Canadian Pacific at Winnipeg, Man., has been promoted to works manager of the Weston shops, succeeding H. B. Bowen.

A. Lupton, general locomotive foreman of the Canadian Pacific at Winnipeg, Man., has been promoted to assistant works manager of the Weston shops.

J. J. Barry, general master mechanic of the Norfolk & Western at Roanoke, Va., has been appointed assistant to the superintendent of motive power, with headquarters at the same point, replacing R. G. Henley.

R. H. Flynn, superintendent of motive power of the Northern division of the Pennsylvania, has been appointed superintendent of motive power of the Western Pennsylvania division, succeeding J. L. Cunningham.

E. W. Smith, general manager of the Eastern region of the Pennsylvania, has been appointed regional vice-president with headquarters at Pittsburgh, Pa. Mr. Smith was born in Clarksburg, W. Va., on September 21, 1885. He was graduated from the Virginia Polytechnic Institute in 1905 and entered railway service in June of that year. Mr. Smith served in various positions in the motive power department of the Pennsylvania and was appointed assistant master mechanic at Wilmington, Del., in October, 1913. He was transferred in the same capacity to Altoona, Pa., in April, 1915. The following year he became assistant engineer of motive power. He was transferred to Harrisburg, Pa., on October 10, 1917, as master mechanic, and on May 26, 1918, he was transferred to Williamsport as superintendent of motive power. He returned to Altoona as superintendent of motive power in December, 1919, and the following year was promoted to engineer of transportation on the staff of the vice-president in charge of operation at Philadelphia. He was appointed general superintendent of motive power at St. Louis, Mo., on October 15, 1922; two years later was promoted to general superintendent of the Western Pennsylvania division and in September, 1926, was appointed general manager of the Eastern region.

E. W. Smith

Henry B. Bowen, who has been promoted to assistant superintendent of motive power of the Western lines of the Canadian Pacific, with headquarters at Winnipeg, Man., was born on May 17, 1884, at Derbyshire, England. At the age of 17 years he became a special apprentice with Crossley Brothers, Manchester, England, and simultaneously completed a three-year course in the Manchester School of Technology. Mr. Bowen entered railway service on May 15, 1905, as an apprentice in the Angus shops of the Canadian Pacific at Montreal, Que. The following year he was advanced to draftsman at Winnipeg; in 1908, promoted to foreman of the wheel and tender shop at the same point; in December, 1909, promoted to shop engineer, and two years later, appointed chief draftsman in the motive power department. He was promoted to works manager at Winnipeg in January, 1920, and his promotion to assistant superintendent of motive power became effective on July 1.

Master Mechanics and Road Foremen

G. S. West, assistant master mechanic of the Pennsylvania at Meadows, N. J., has been promoted to master mechanic of the Conemaugh division, with headquarters at Pittsburgh, Pa.

H. D. MacKenzie, master mechanic of the Canadian National at Campbellton, N. B., has retired under the pension regulations of that road.

Page Carlisle, locomotive foreman of the Canadian National at Moncton, N. B., will succeed H. D. MacKenzie as master mechanic at Campbellton, N. B.

E. L. Bachman, master mechanic of the Cleveland division of the Pennsylvania has been transferred to the Buffalo division to succeed D. K. Chase, at Olean, N. Y.

H. D. Carpenter, enginehouse foreman of the Pennsylvania at Zanesville, Ohio, has been promoted to assistant master mechanic of the Akron division, succeeding H. L. Nancarrow.

H. S. Noble, master mechanic of the Erie and Ashtabula division of the Pennsylvania at Mahonington, Pa., has been transferred to the Cleveland division, with headquarters at Wellsville, Ohio. Mr. Noble replaces E. L. Bachman.

Stores Department

C. E. Walsh, purchasing agent of the Pennsylvania at Philadelphia, Pa., has been appointed purchasing agent of the Long Island, with headquarters at the same city.

B. P. Phillippe, fuel purchasing agent of the Pennsylvania, has been appointed fuel purchasing agent of the Long Island, with headquarters as before at Philadelphia.

Edwin Meyer, who has been promoted to general storekeeper of the Louisville & Nashville, with headquarters at South Louisville, Ky., was born in Louisville on December 3, 1885. He entered the service of the Louisville & Nashville at the age of 17 years as a stenographer in the stores department at Louisville. During the time he was stenographer with the Louisville & Nashville he completed a course in the Jefferson School of Law in Louisville. In September, 1914, Mr. Meyer was promoted to chief clerk, and in January, 1916, he was appointed assistant general storekeeper. His promotion to general storekeeper became effective on May 1.

Edwin Meyer

George Kefer, purchasing agent of the Long Island at New York, has been appointed assistant purchasing agent, with headquarters at the same city.

C. B. Hall, stores manager of the Pennsylvania at Philadelphia, has been appointed to the same position on the Long Island, with headquarters at the same point.